

THE GREAT ALASKA EARTHQUAKE

Volume II

Illustrations and Maps

Walter E. Fisher, Ph.D.

Douglas H. Merkle

Captain USAF

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TECHNICAL REPORT NO. AFWL-TR-65-92, Vol II

November 1965

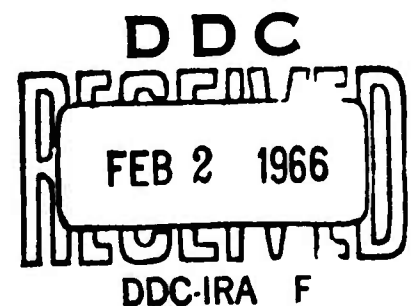
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FOREWORD

This report was prepared under Project 5713, Program Element 6.24.05.06.4. Inclusive dates of research were 1 May 1964 to 1 October 1964. The report was submitted on 10 June 1965 by the Project Engineer, Dr. W. E. Fisher, Air Force Weapons Laboratory (WLDC).

This study, sponsored by the Civil Engineering Branch, Development Division, AFWL, resulted from an on-site survey made by the authors in May 1964 throughout the Anchorage area. However, many other persons and organizations gave of their time and talents to provide data included in this report which will complement the growing body of literature documenting the Good Friday Alaska disaster.

Special acknowledgment is due the city officials and residents of Anchorage and the other stricken communities who, despite their own personal concern with the calamity, assisted so generously in providing access and information vital to our study. Similarly, the personnel at several government installations, Elmendorf AFB, Fort Richardson, and other establishments, gave unstinting assistance. Business and industrial concerns, local engineers and technicians, and many private citizens all contributed to the great body of information gathered. The writers, editors, and publications specialists at AFWL and AFSWC extended their most professional efforts to make this report of service to a large and diverse audience. Space precludes any attempt to single out individuals for our thanks. However, our gratitude must be expressed to Colonel Paul W. Stephens, DCS/Civil Engineering, Alaskan Air Command, for providing certain financial support and convenient office space for the authors.

Photographs, maps, and drawings illustrating this report are principally derived from USAF sources. Many of the photographs were taken by the authors or under their supervision. Sources for the basic maps used in this report are the US Department of the Interior, US Coast and Geodetic Survey, US Army Corps of Engineers, and the City Engineers, City of Anchorage, Alaska.

Credit is due the US Army for the following figures:

Figures 9, 10, 11, 15, 16, 17, 18, 19, 20, 21, 22, 26, 27, 28, 29, 30, 31, 32, 34, 38, 39, 44, 45, 54, 55, 56, 58, 59, 60, 61, 62, 63, 64, 65, 67, 70, 74, 77, 78, 81, 83, 89, 95, 96, 99, 100, 103, 104, 115, 117, 137, 138, 139, 140, 157, 218, 227, 243, 281, and 282.

MAC'S FOTO SHOP, Anchorage, Alaska, is the source for figures 94, 114, 134, 135, 136, 187, 216, 219, and 278.

The Anchorage Daily Times is credited with figures 66 and 69.

This technical report has been reviewed and is approved.

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ABSTRACT

Volume II of AFWL-TR-65-92, The Great Alaska Earthquake, consists of the photographs, maps, and drawings which supplement Volume I of this report. Credits for these illustrations are given in the Foreword.

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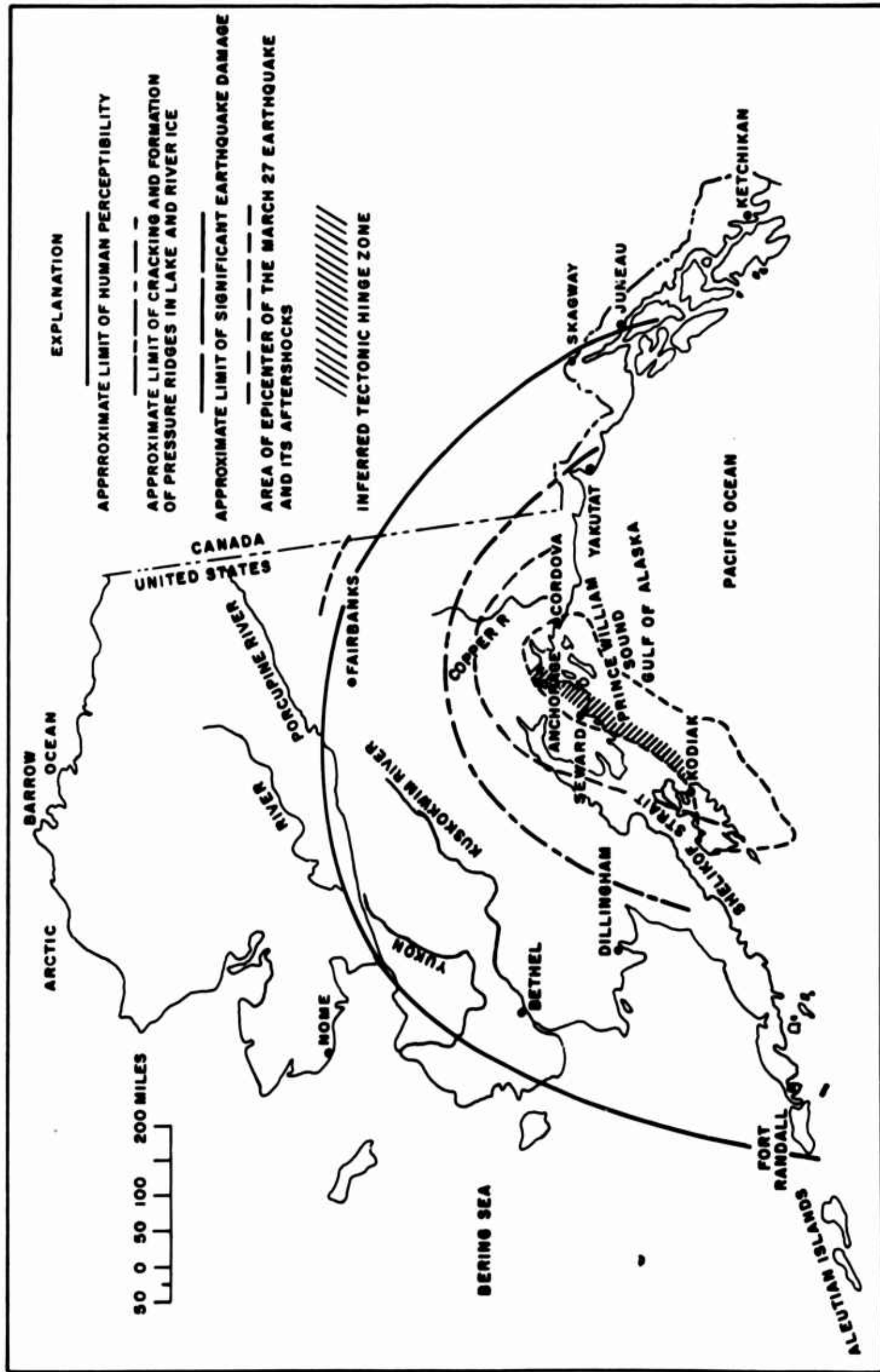


Figure 1. Map of Alaska (Showing the area affected by the earthquake and the inferred Tectonic Hinge Zone)
(Source: Reference I-1)

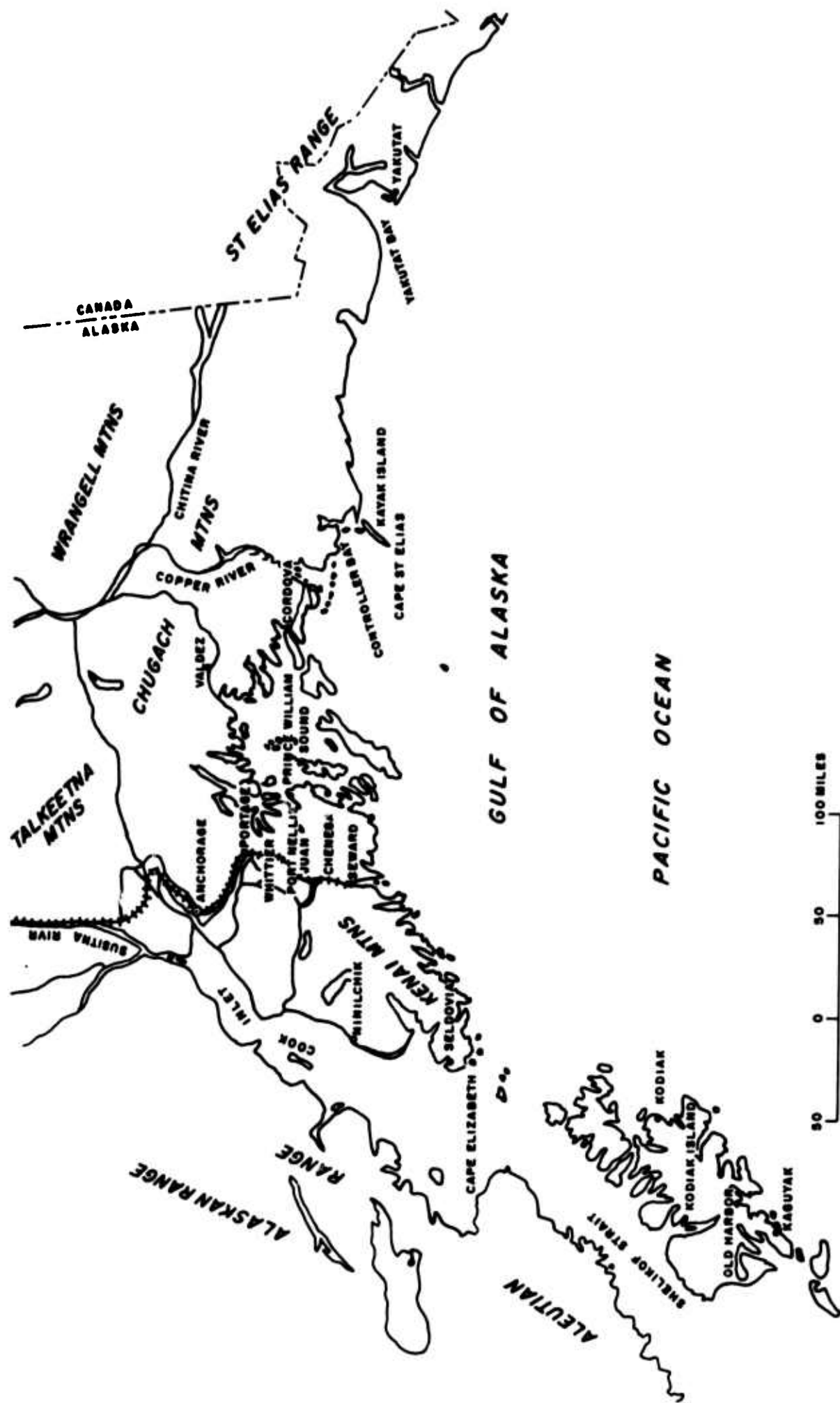
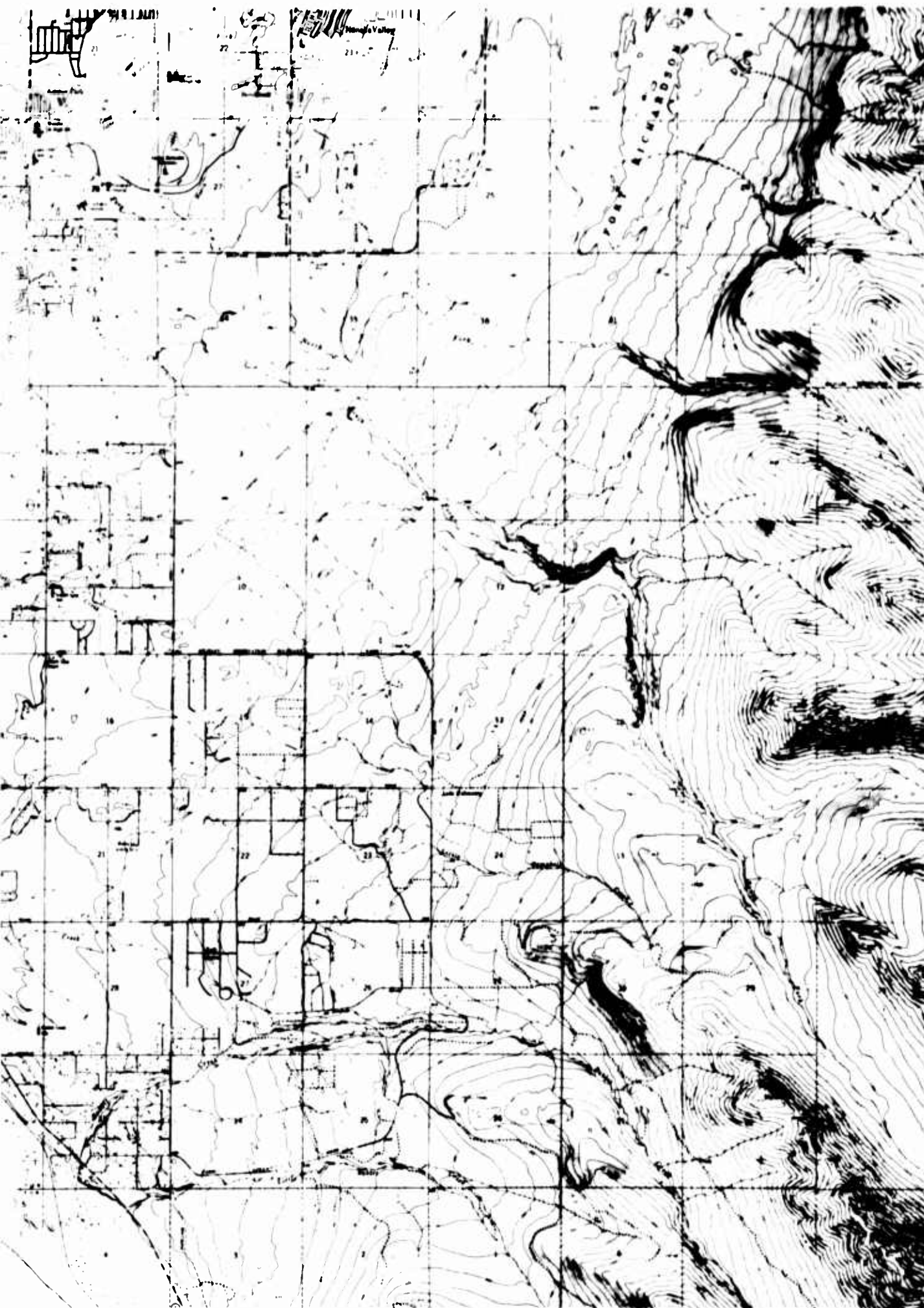


Figure 2. Map of South-Central Alaska (Showing the mountain ranges in the area)



Figure 3b. Map of the Greater Anchorage



Storage Area (Southern Half)

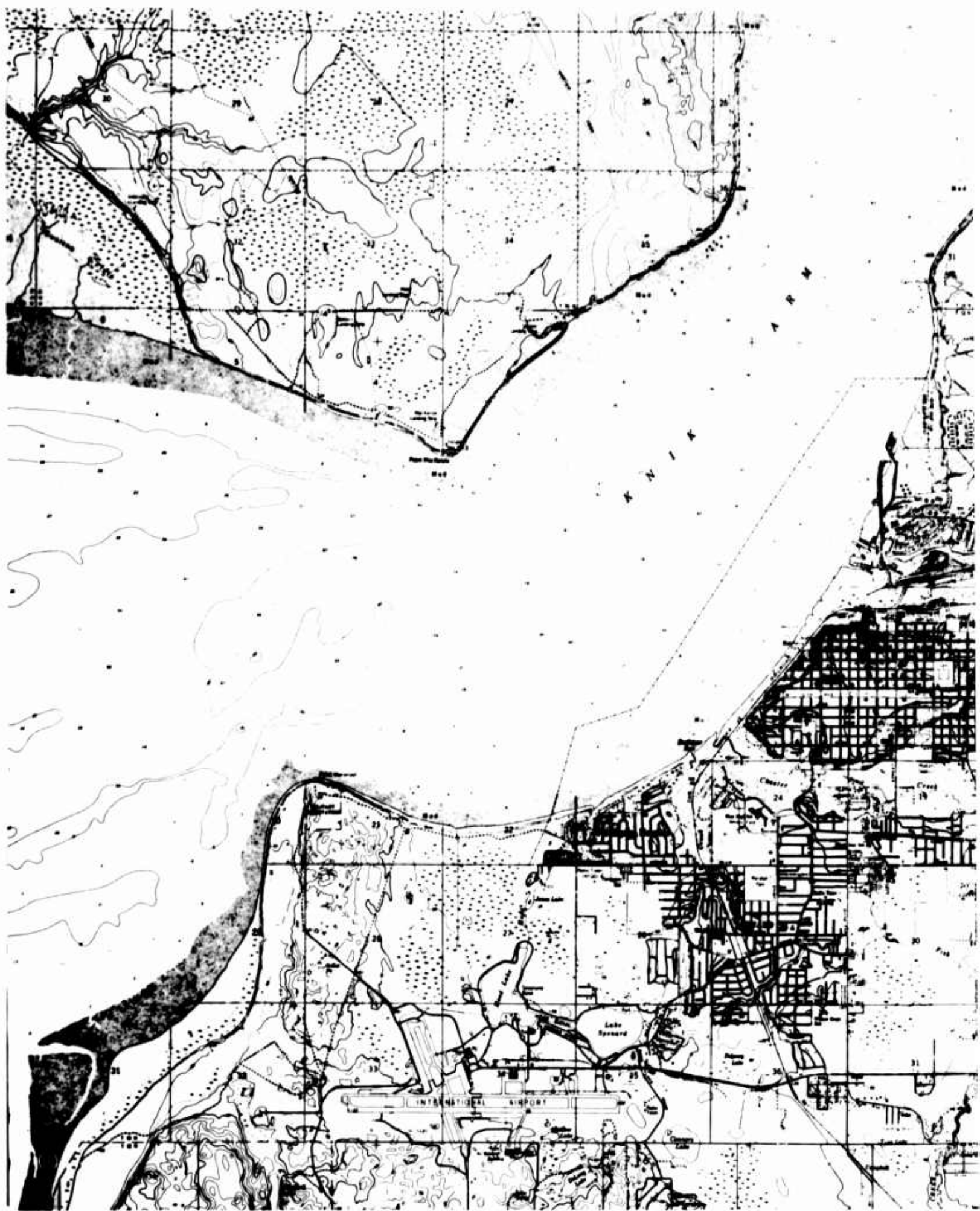
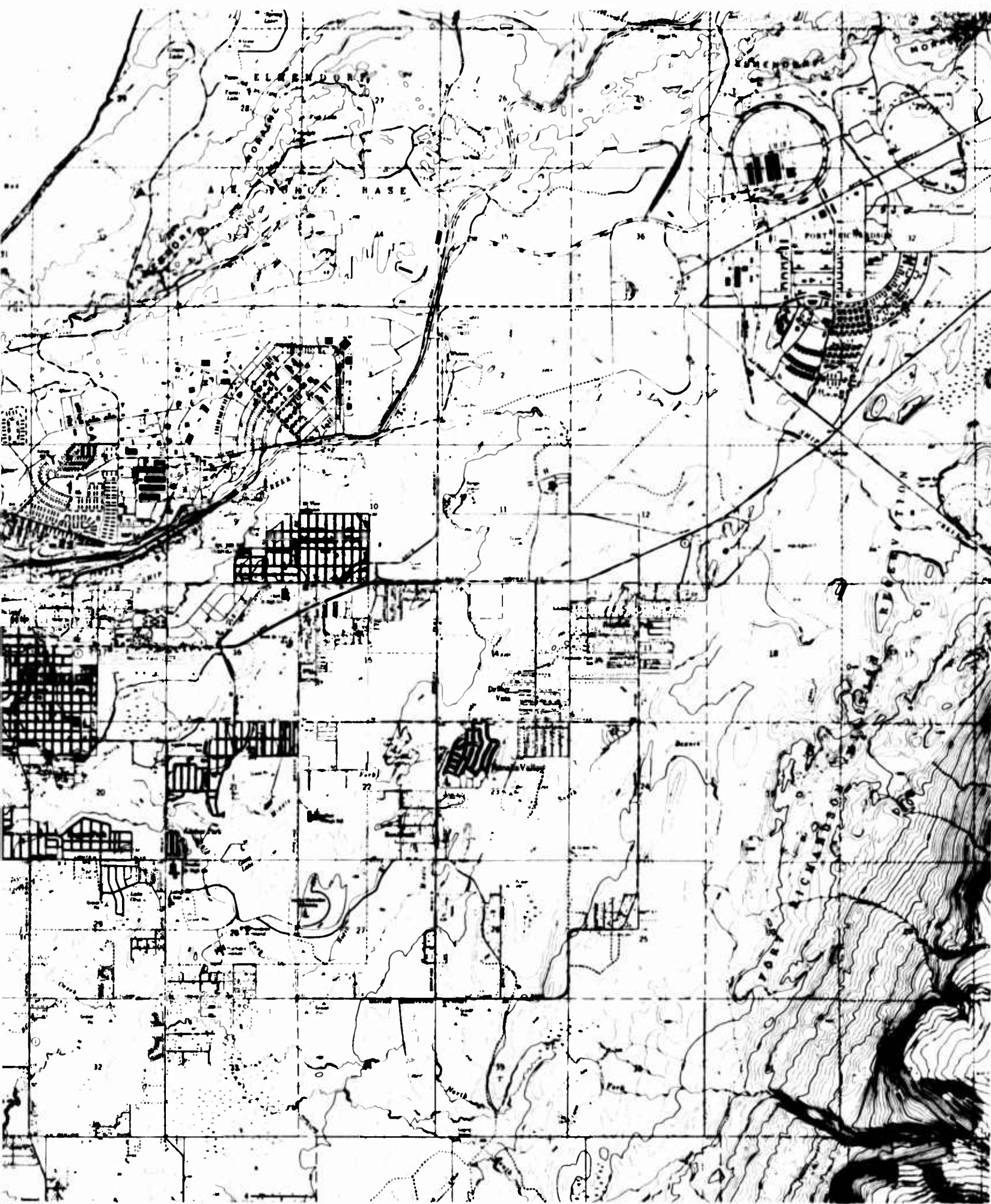


Figure 3a. Map of the Greater



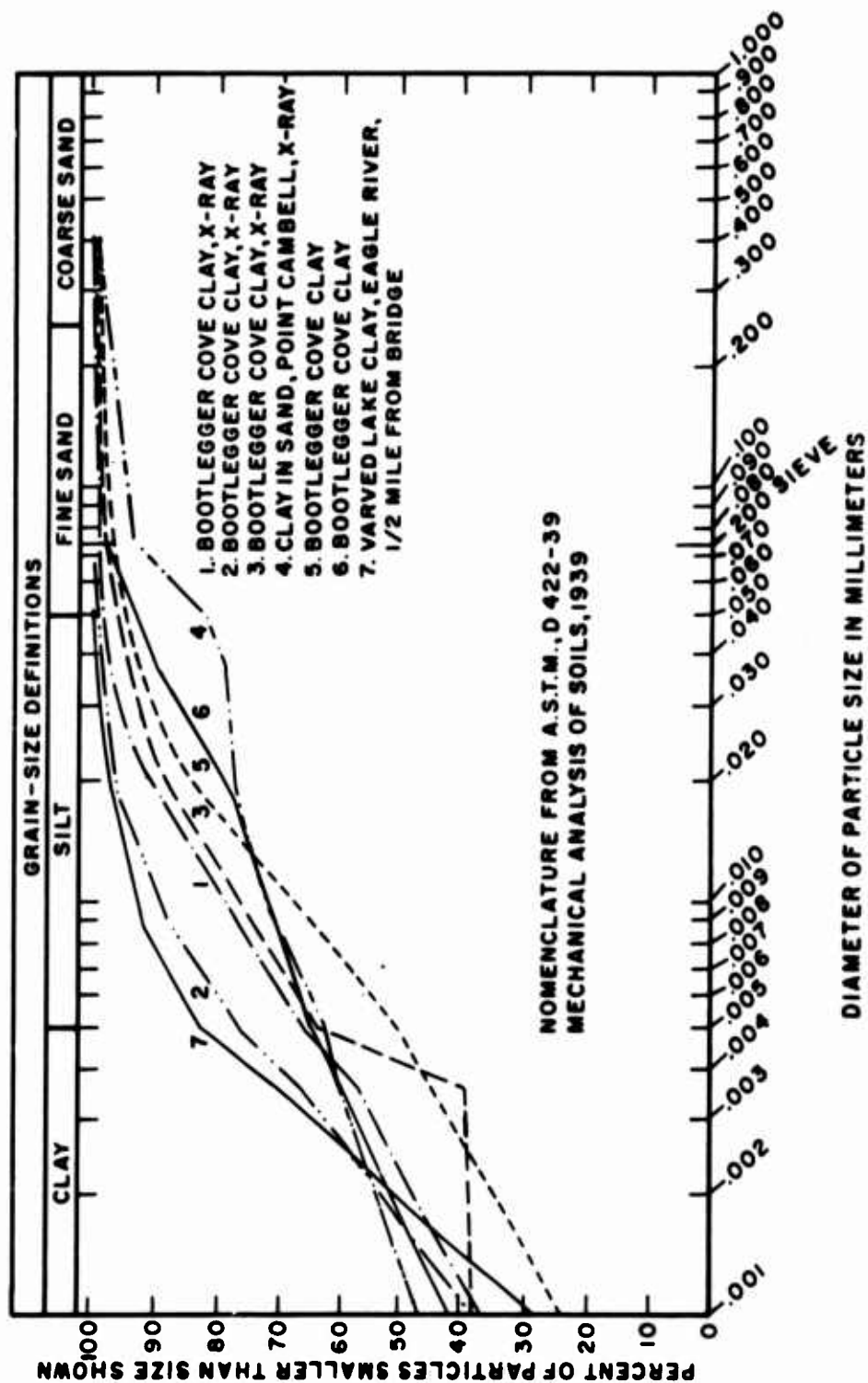


Figure 4. Grain-Size Curves for Bootlegger Cove Clay
(Source: Reference IV-4)

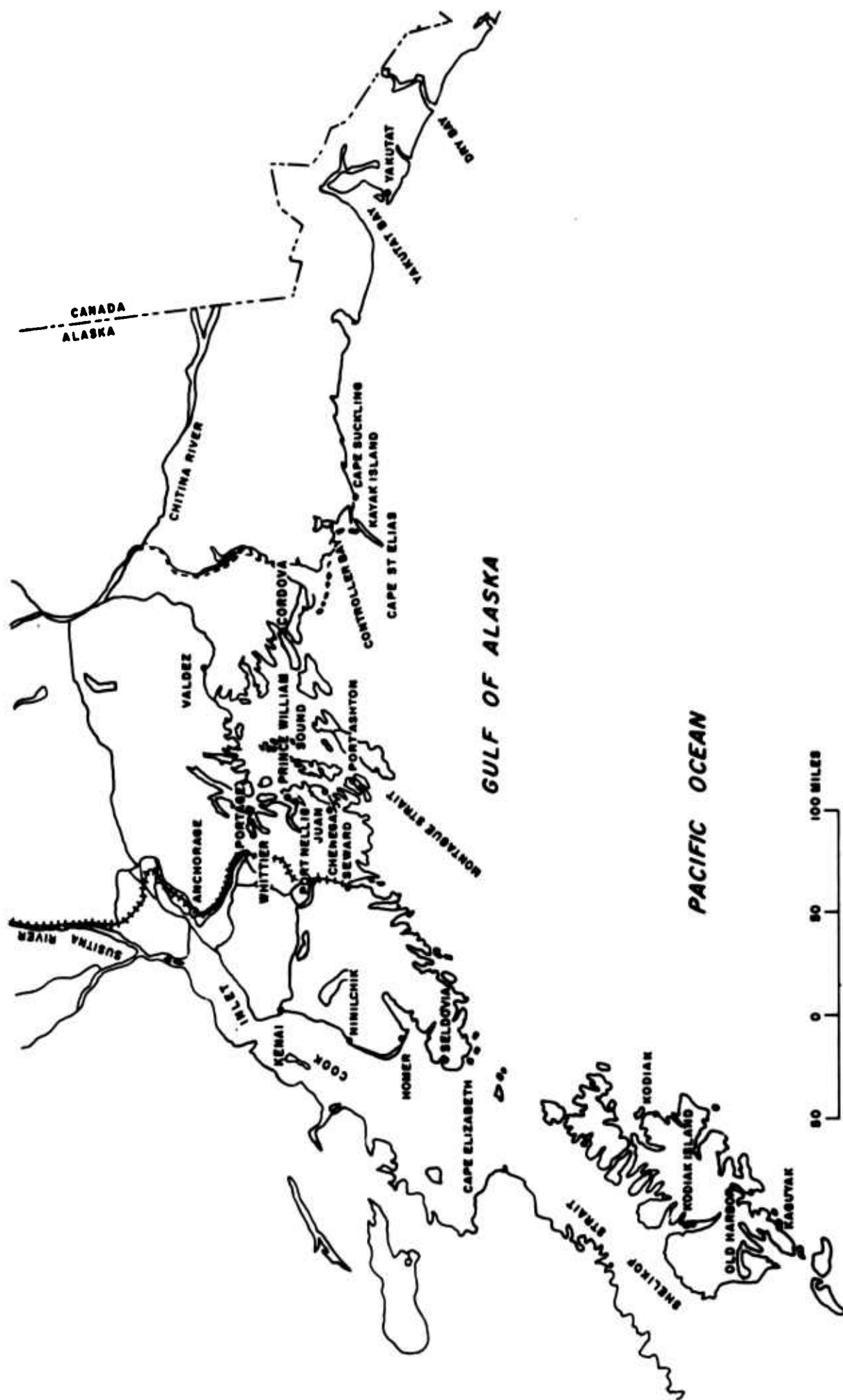


Figure 6. Map of South-Central Alaska (Showing communities affected by the earthquake)

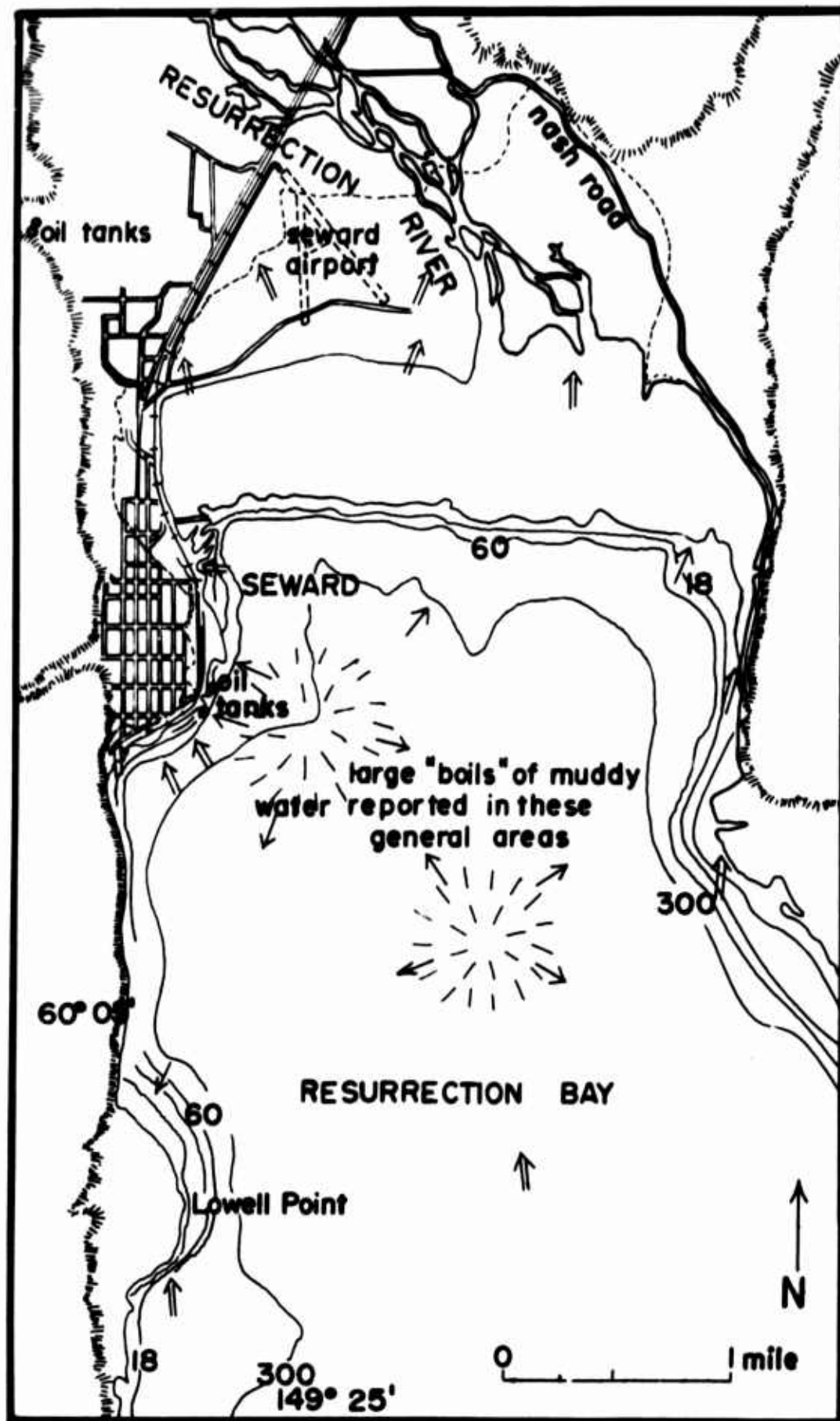


Figure 7. Map of Resurrection Bay (Showing Seward, Alaska)
(Source: Reference VI-2)

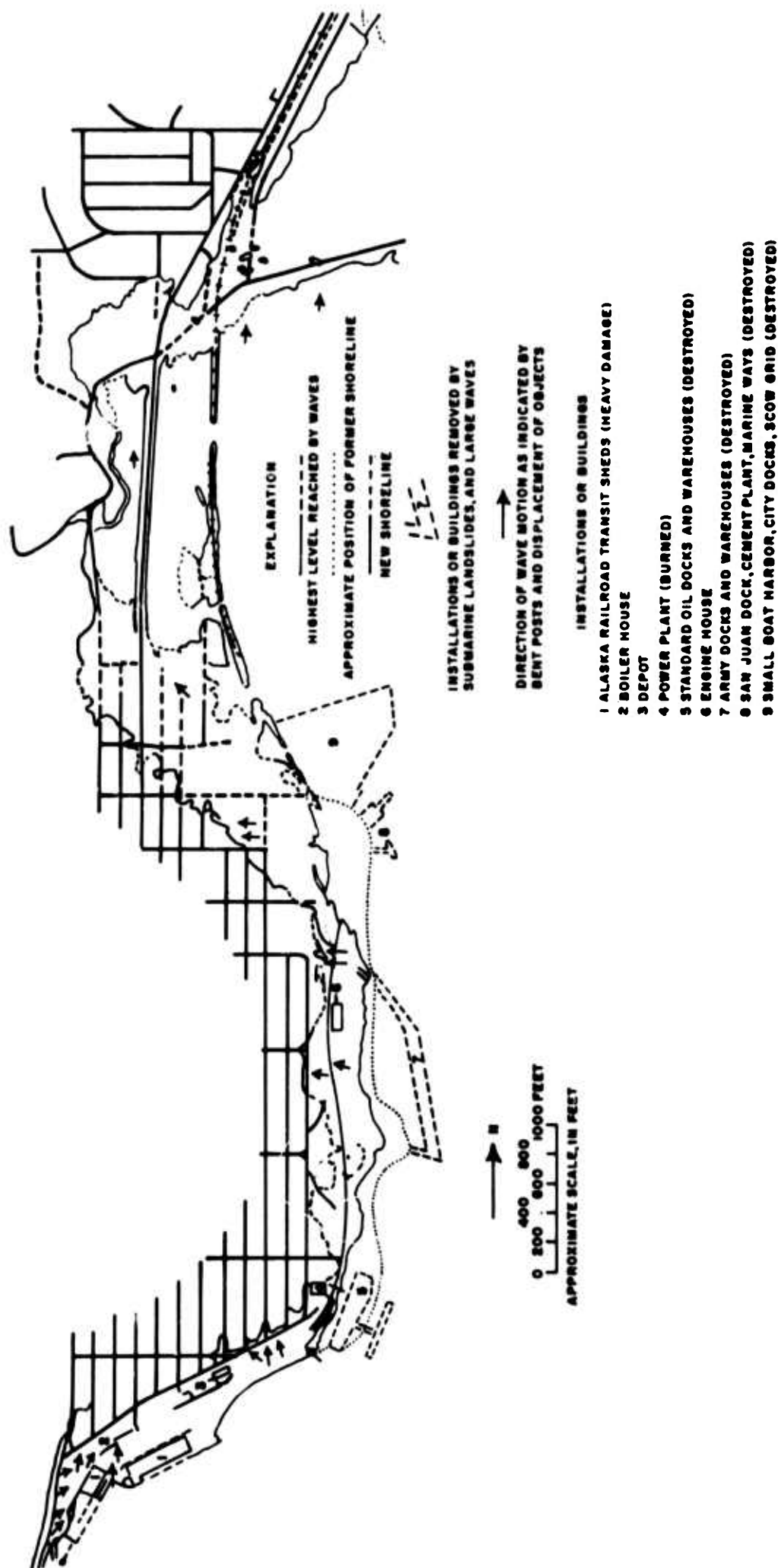


Figure 8. Map of Seward (Showing damage by submarine landslide and tsunami)
(Source: Reference VI-2)



Figure 9. Seward, Mosaic, Vertical Aerial Projection



Figure 10. Seward, Aerial View of the Central Section of the City



Figure 11. Seward, Aerial View of the Southern Section of the City

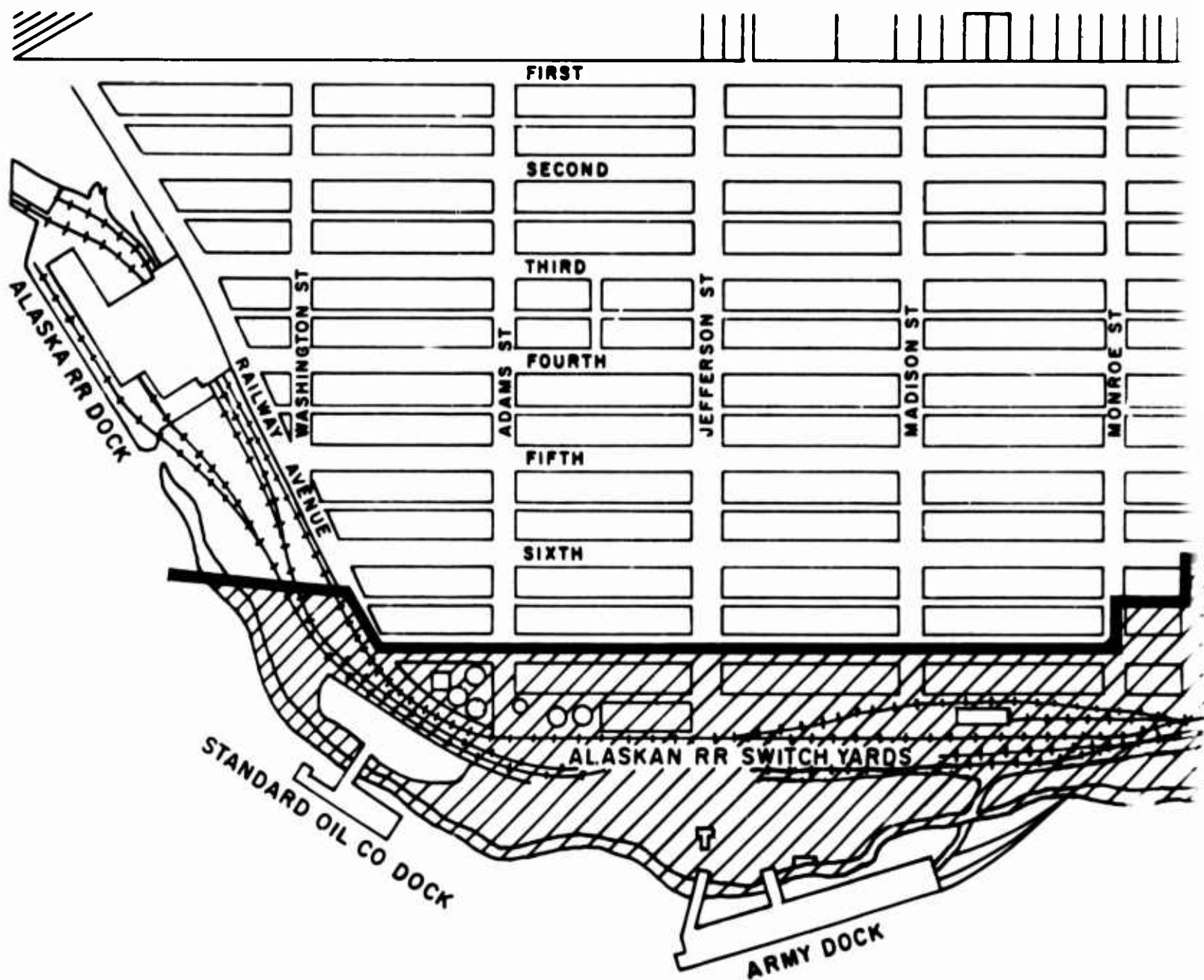
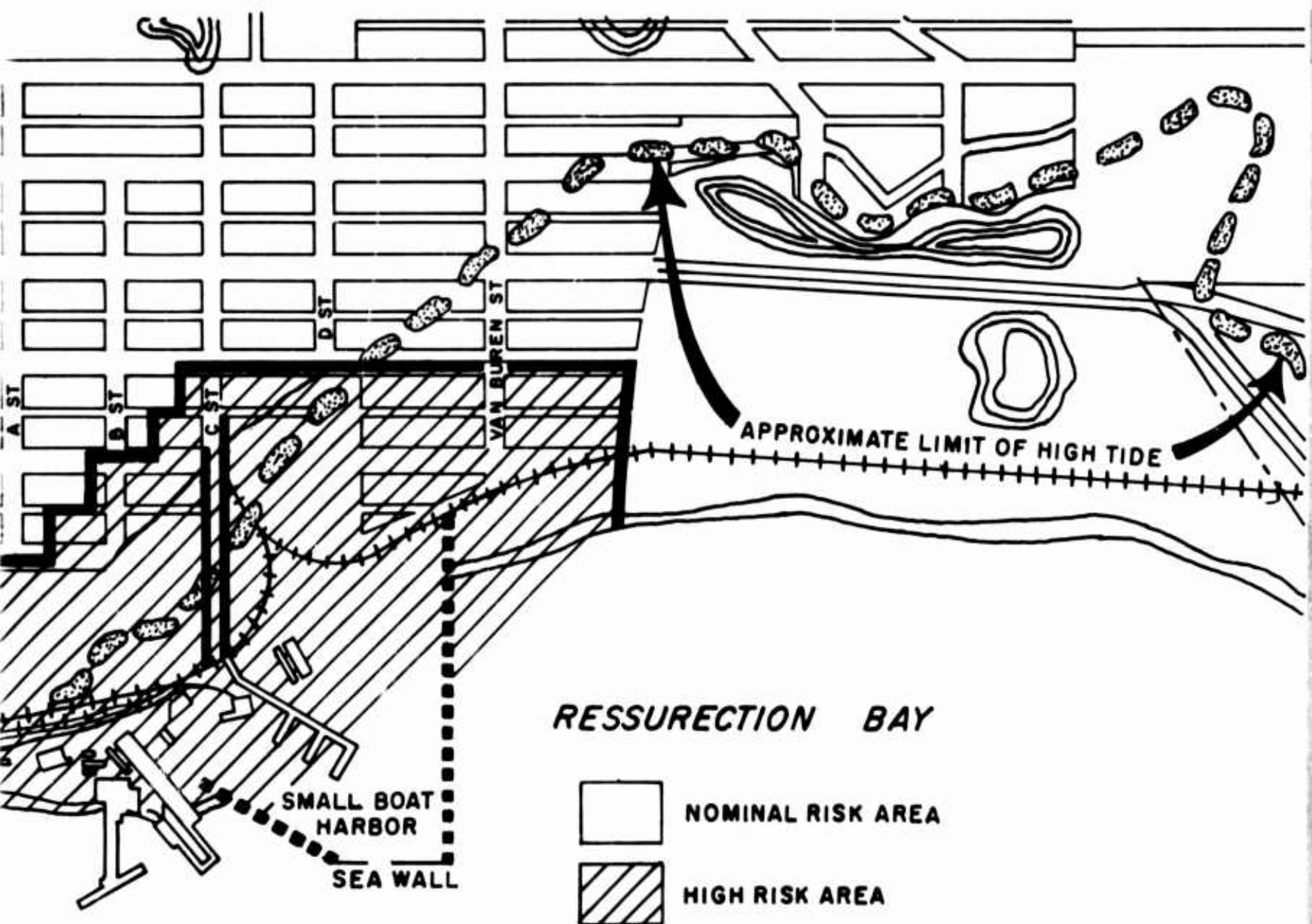


Figure 12. Seward, Waterfront, I

A



High-Risk Area (Source: Reference VI-9)

B

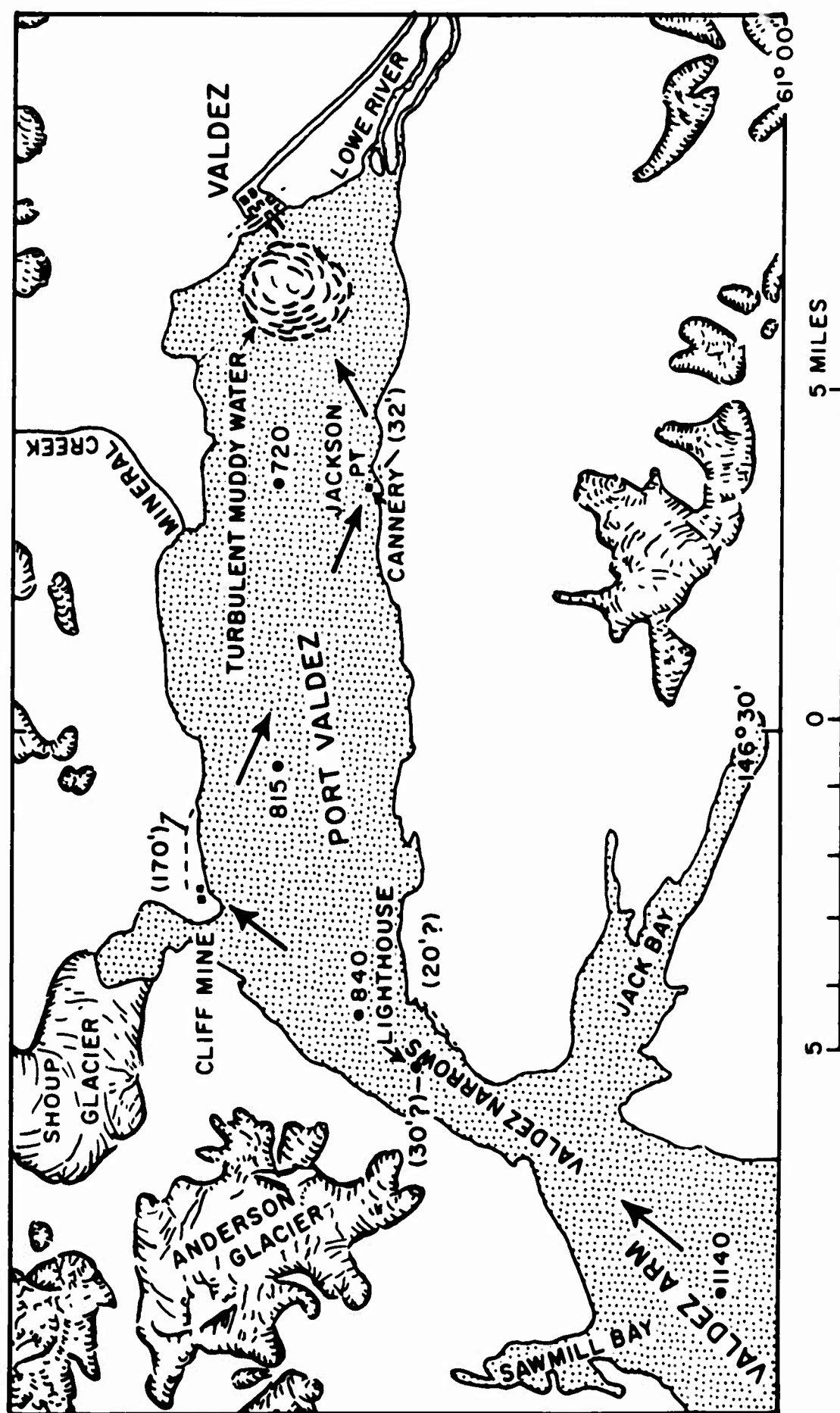


Figure 13. Map of Valdez and Vicinity
(Source: Reference IX-2)

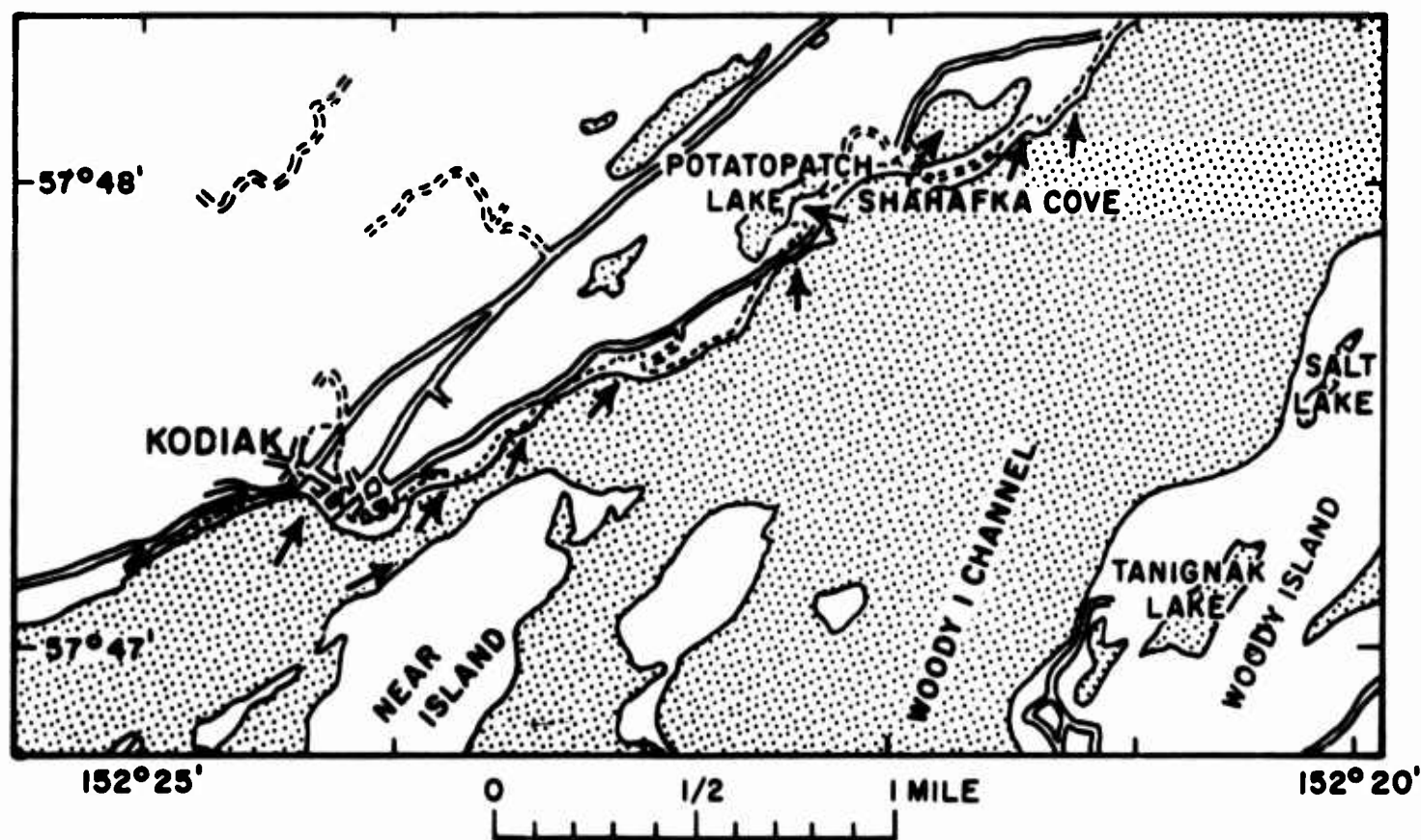


Figure 14. Map of Kodiak and Vicinity
(Source: Reference IX-2)



Figure 15. A Damaged Bridge, Anchorage to Seward Highway



Figure 16. A Damaged Bridge, Anchorage to Seward Highway



Figure 17. A Cambered Bridge, Anchorage to Seward Highway



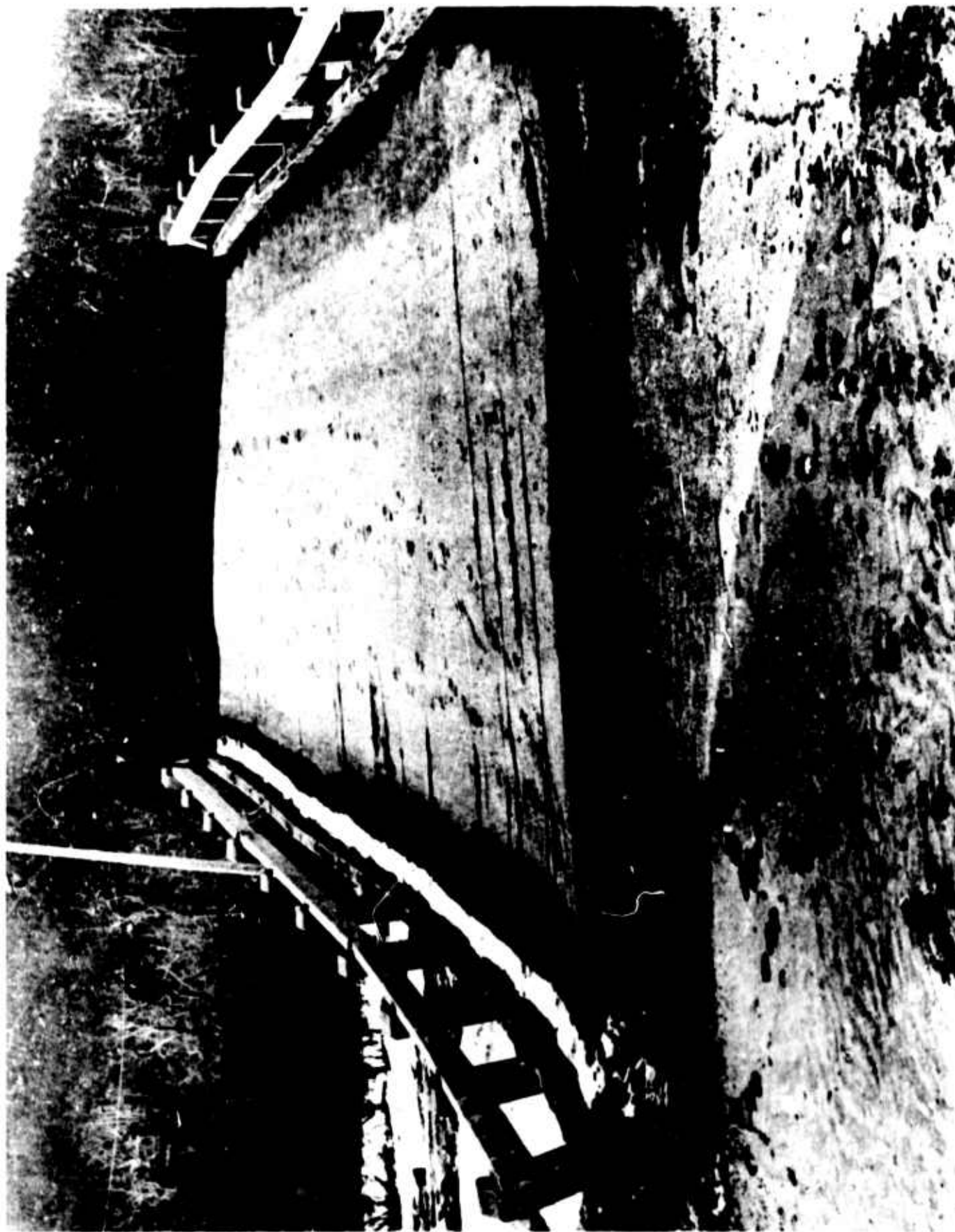


Figure 19. A Cambered Bridge, Anchorage to Seward Highway



Figure 20. Roadbed Subsidence Adjacent to a Bridge, Anchorage to Seward Highway



Figure 21. Roadbed Subsidence Adjacent to a Bridge, Anchorage to Seward Highway



Figure 22. Railroad Bridge in Seward Destroyed by Seismic Sea Wave

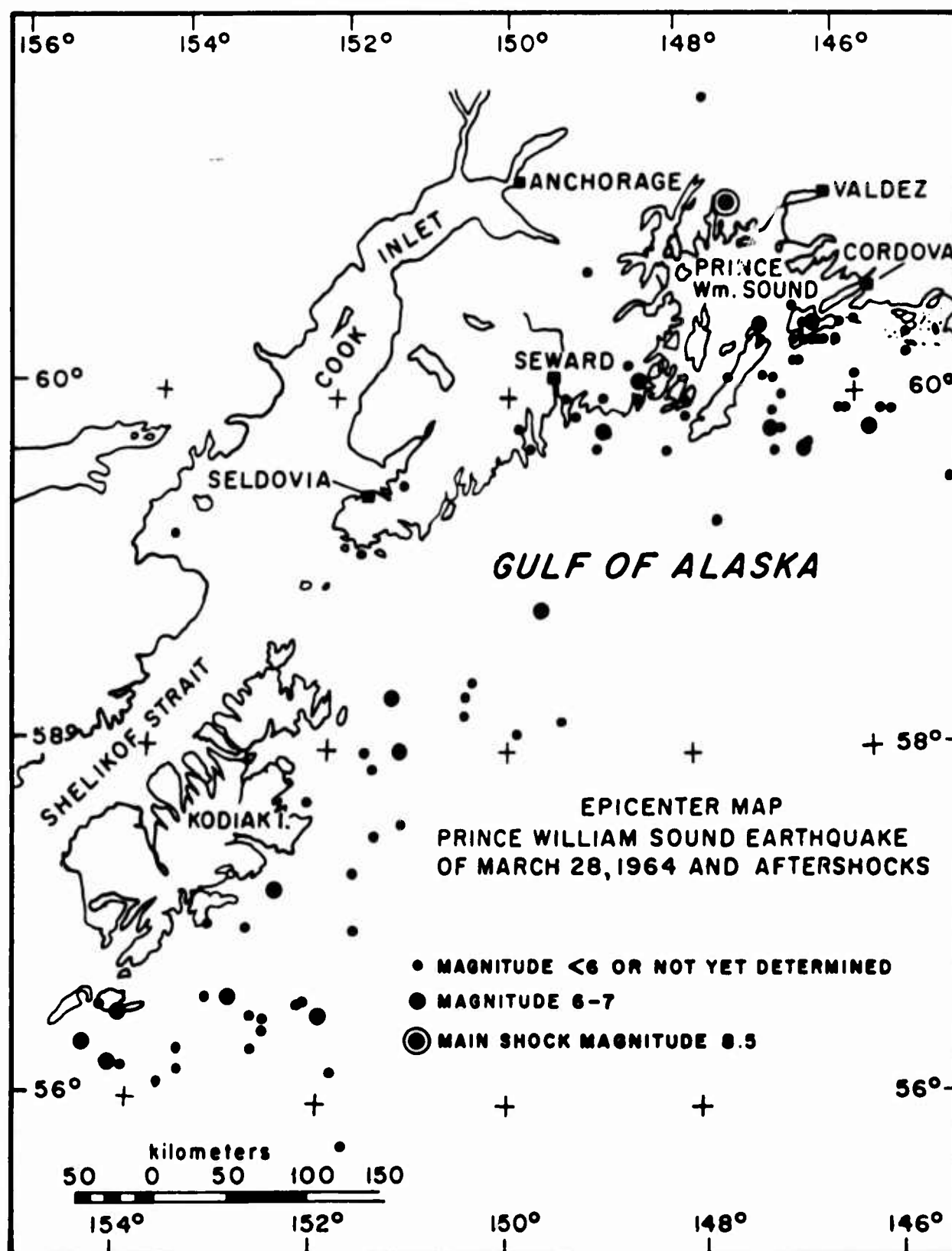


Figure 23. Location of the Epicenter and Main Aftershocks of the March 27, 1964, Alaska Earthquake (Source: Reference VII-2)

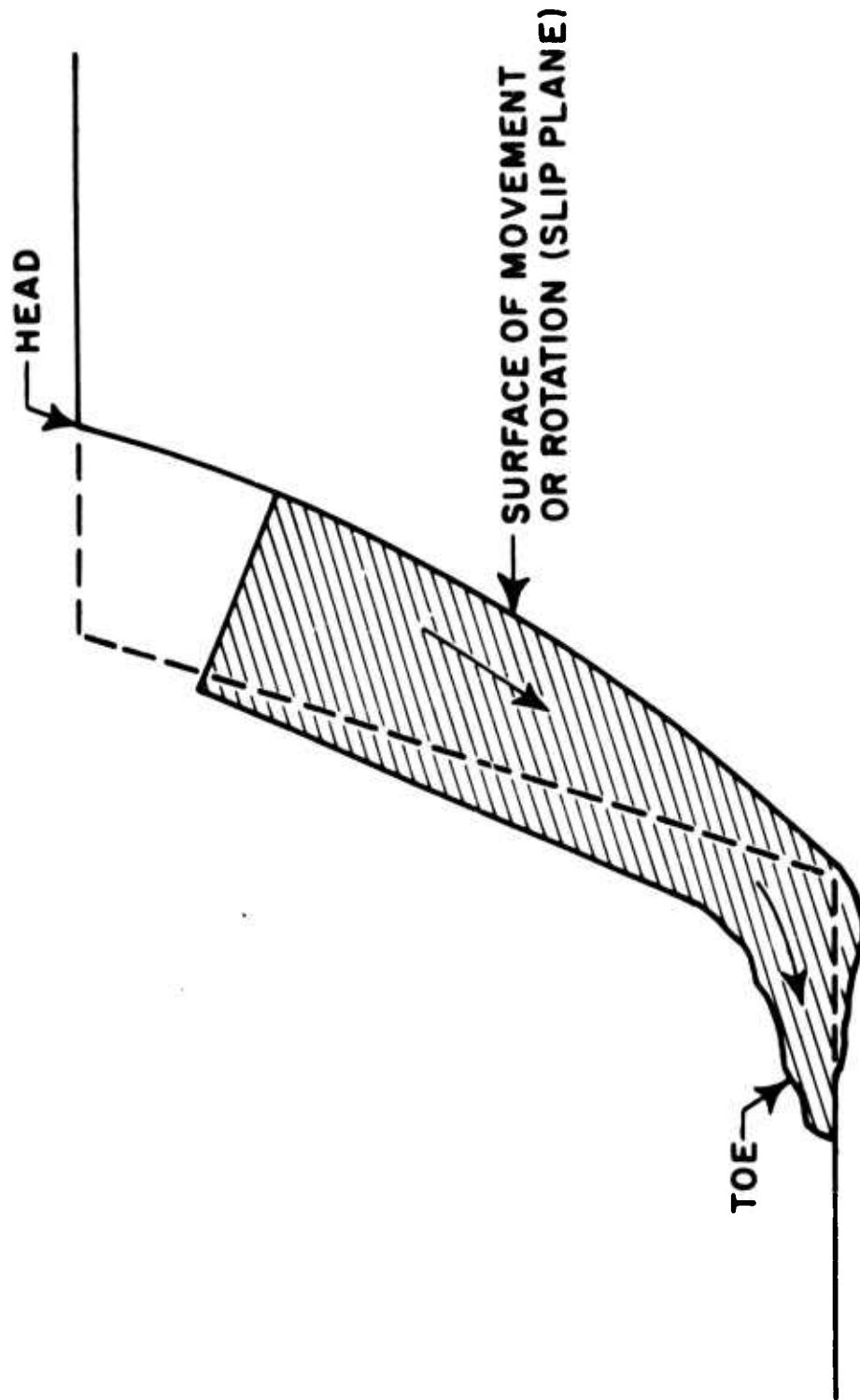


Figure 24. Idealized Rotational-Type Landslide

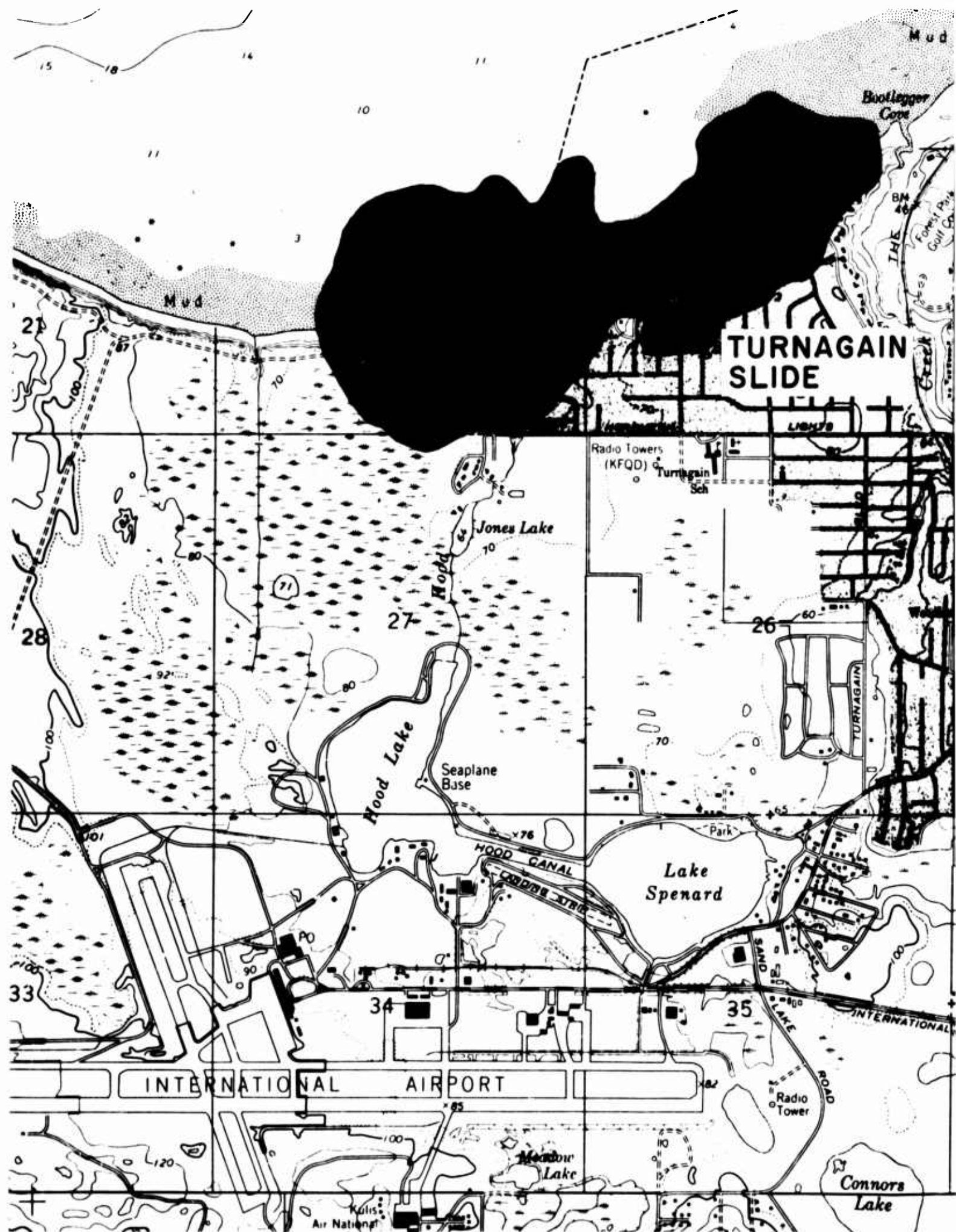
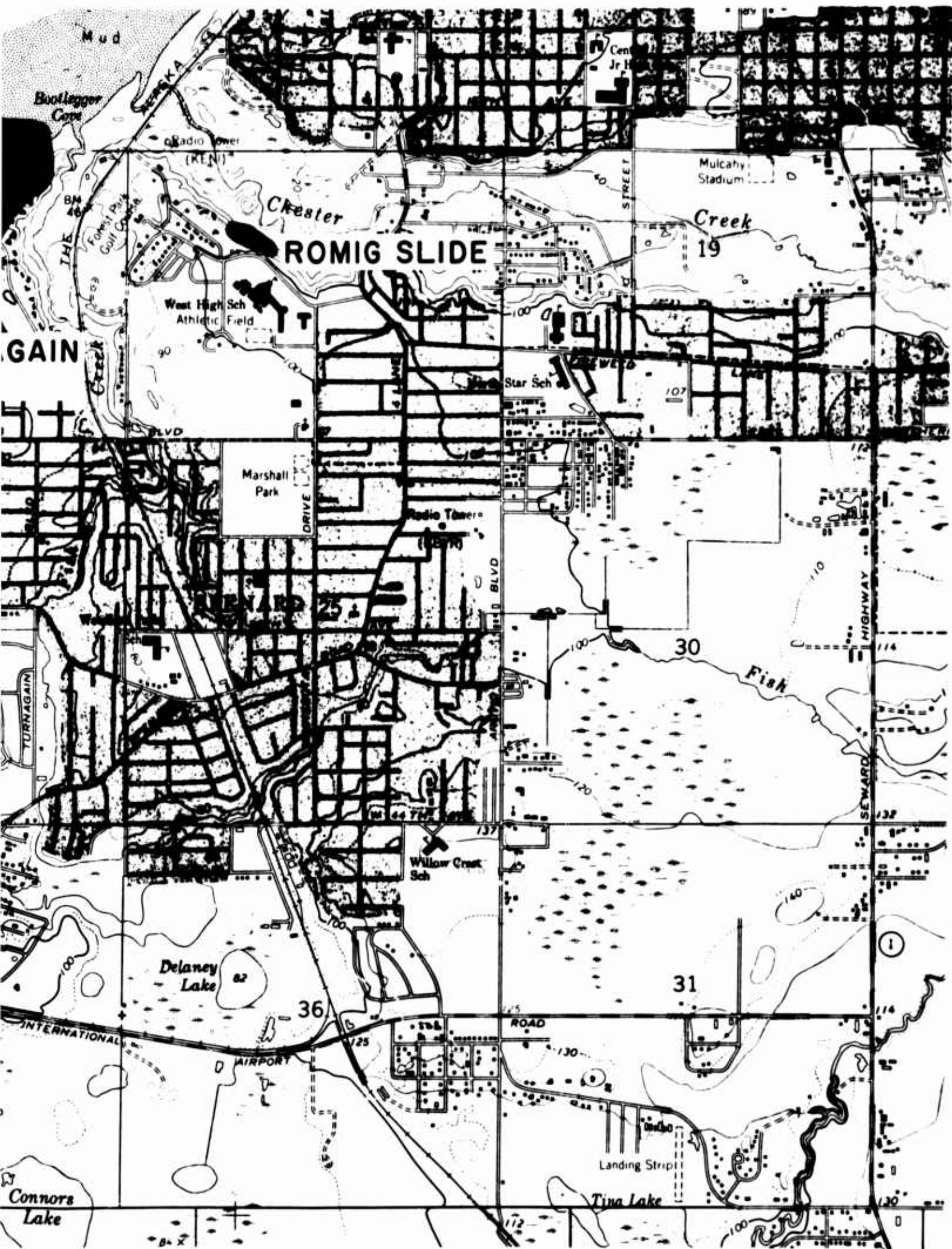


Figure 25b. Map of Anchorage (Showing locations of the major
(Source: Reference)



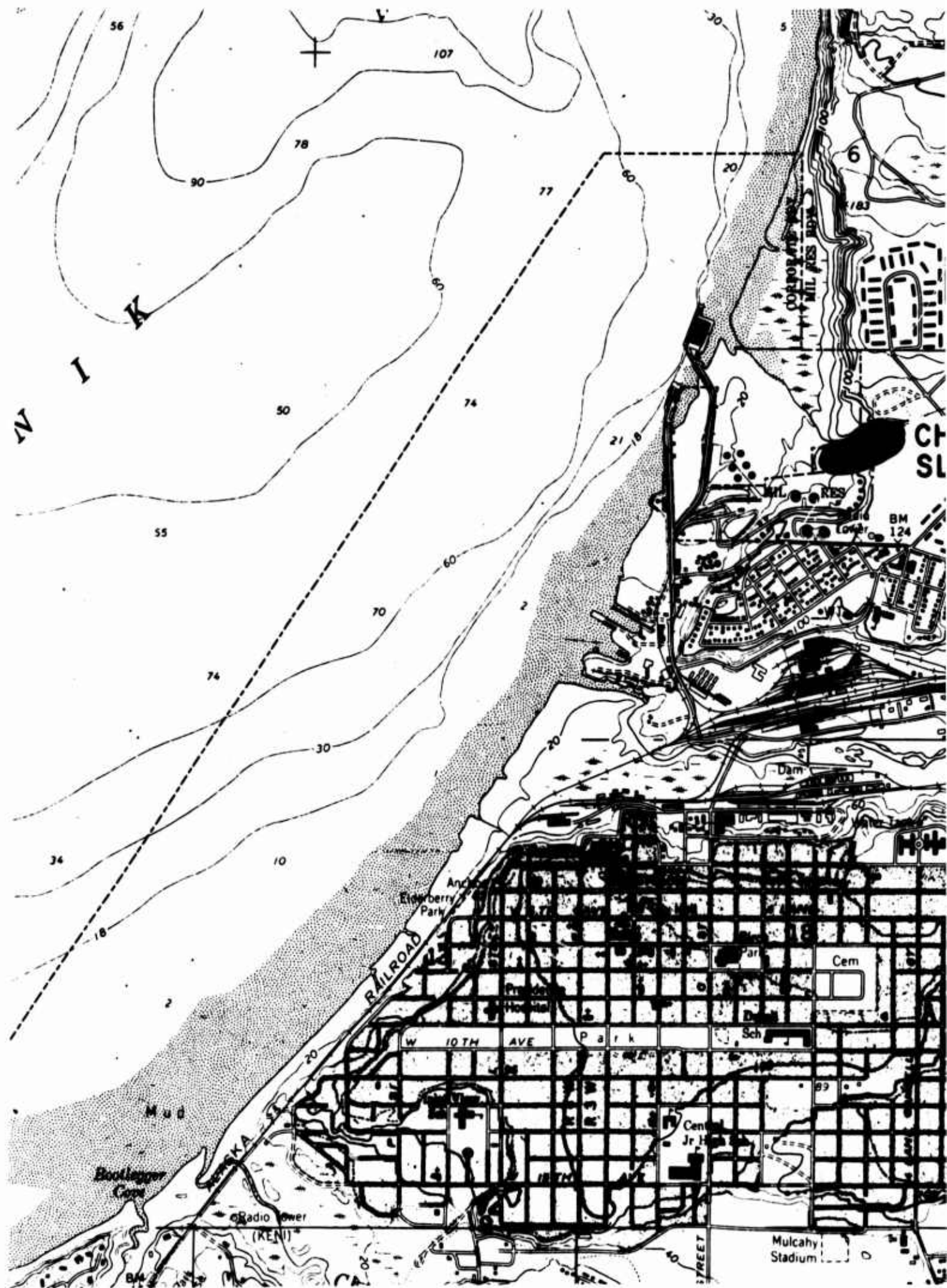


Figure 25a. Map of Anchorage (Showing locations of the
(Source: Re



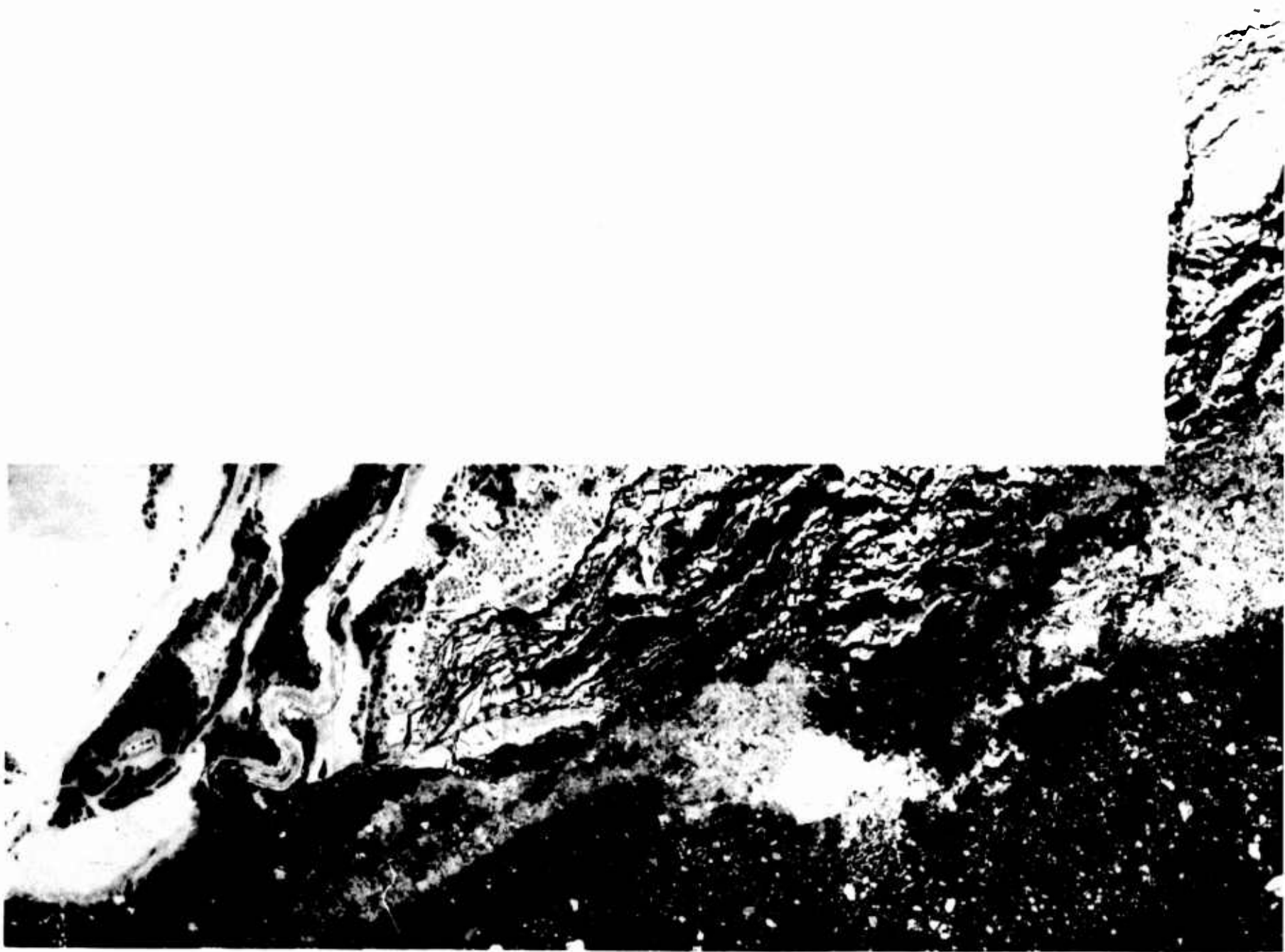


Figure 27. Turnagain Slide, Mosaic, Vol





Figure 27. Turnagain Slide, Mosaic,

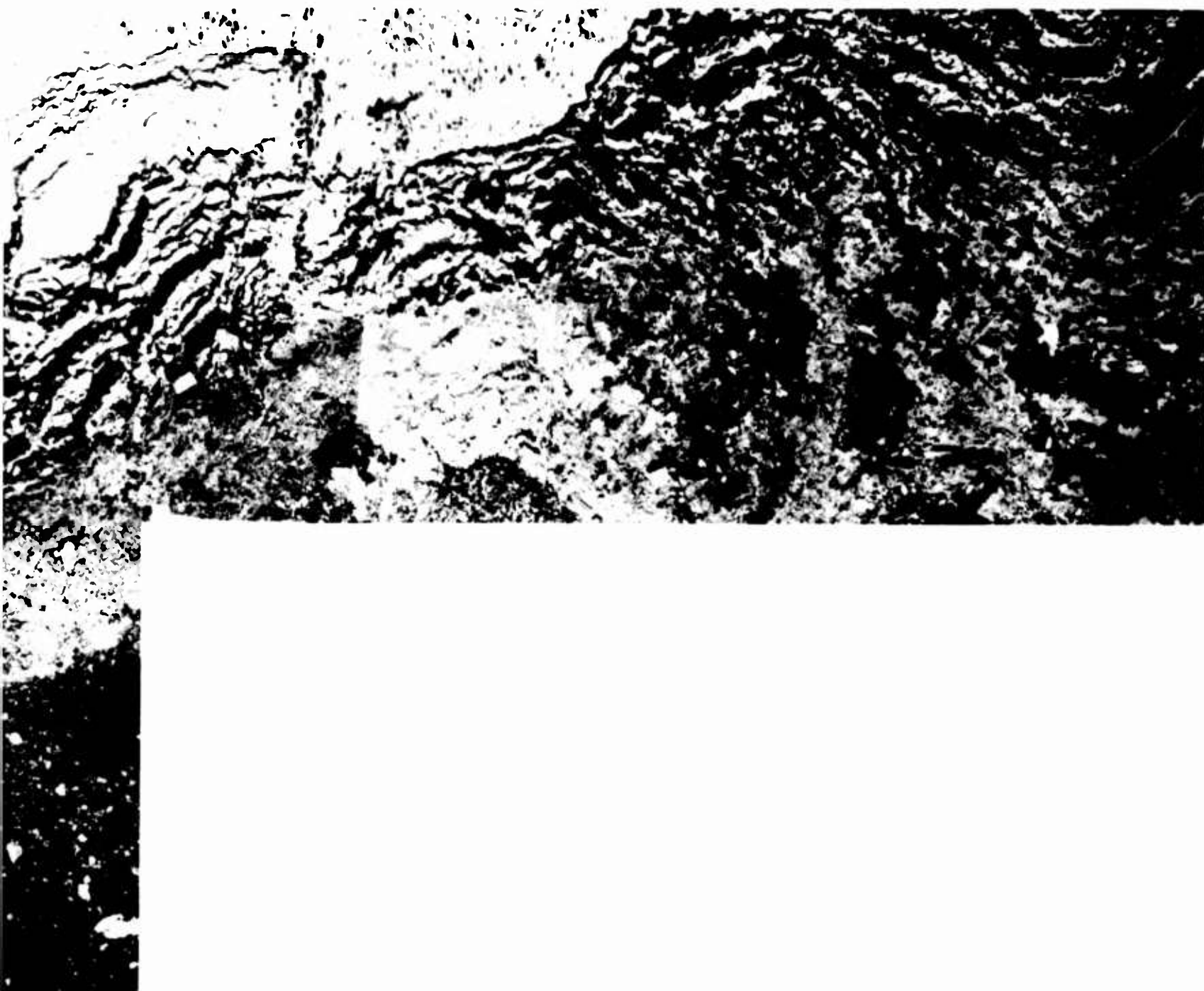




Figure 28. Turnagain Slide (Slide blocks)





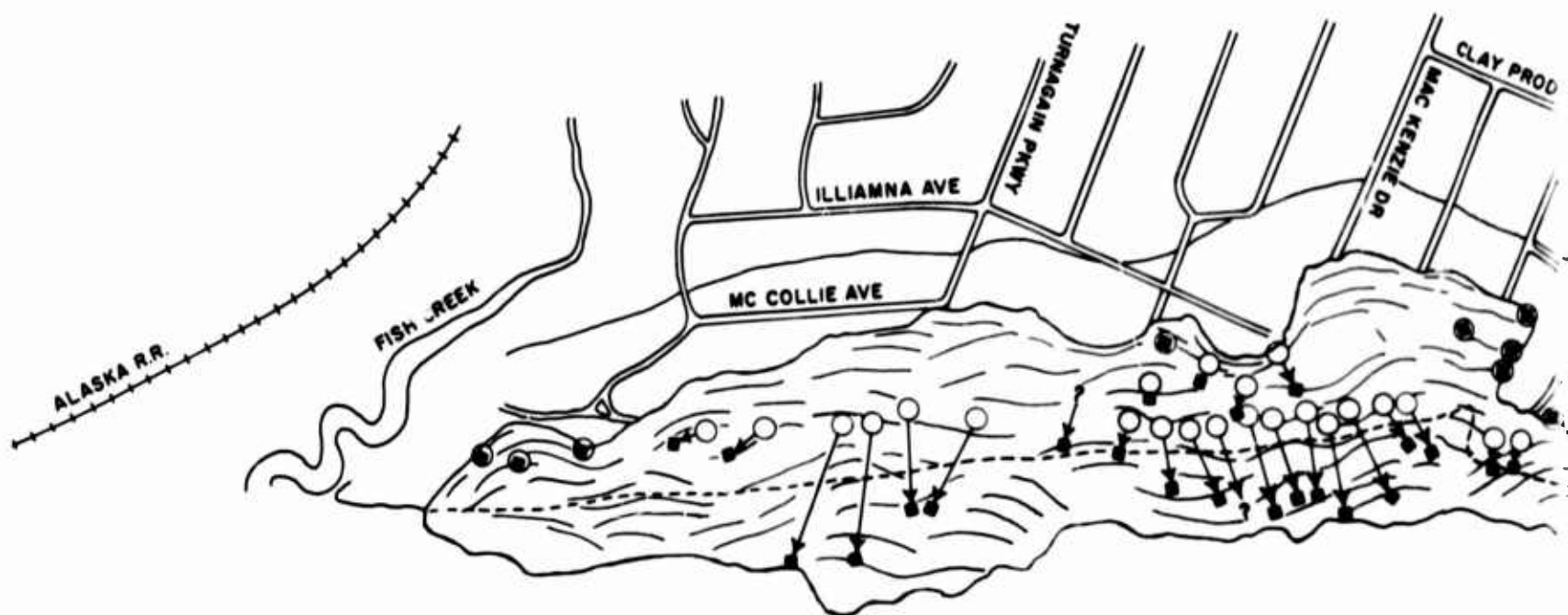
Figure 30. Turnagain Slide (Present cliff near west end of residential area)



Figure 31. Turnagain Slide (Inhabited region)



Figure 32. Turnagain Slide (Uninhabited region)



MOVEMENT OF HOUSES-TURNAGAIN SLIDE AREA

DATA FROM AIR PHOTOS, 30 MARCH 1964 AND TAX RECORDS

0 500 1000
FEET
APPROXIMATE - ± 10-15%

BEFORE QUAKE ○
AFTER QUAKE ■

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Figure 33. Turnagain Slide (Displacement)
(Source: Reference)

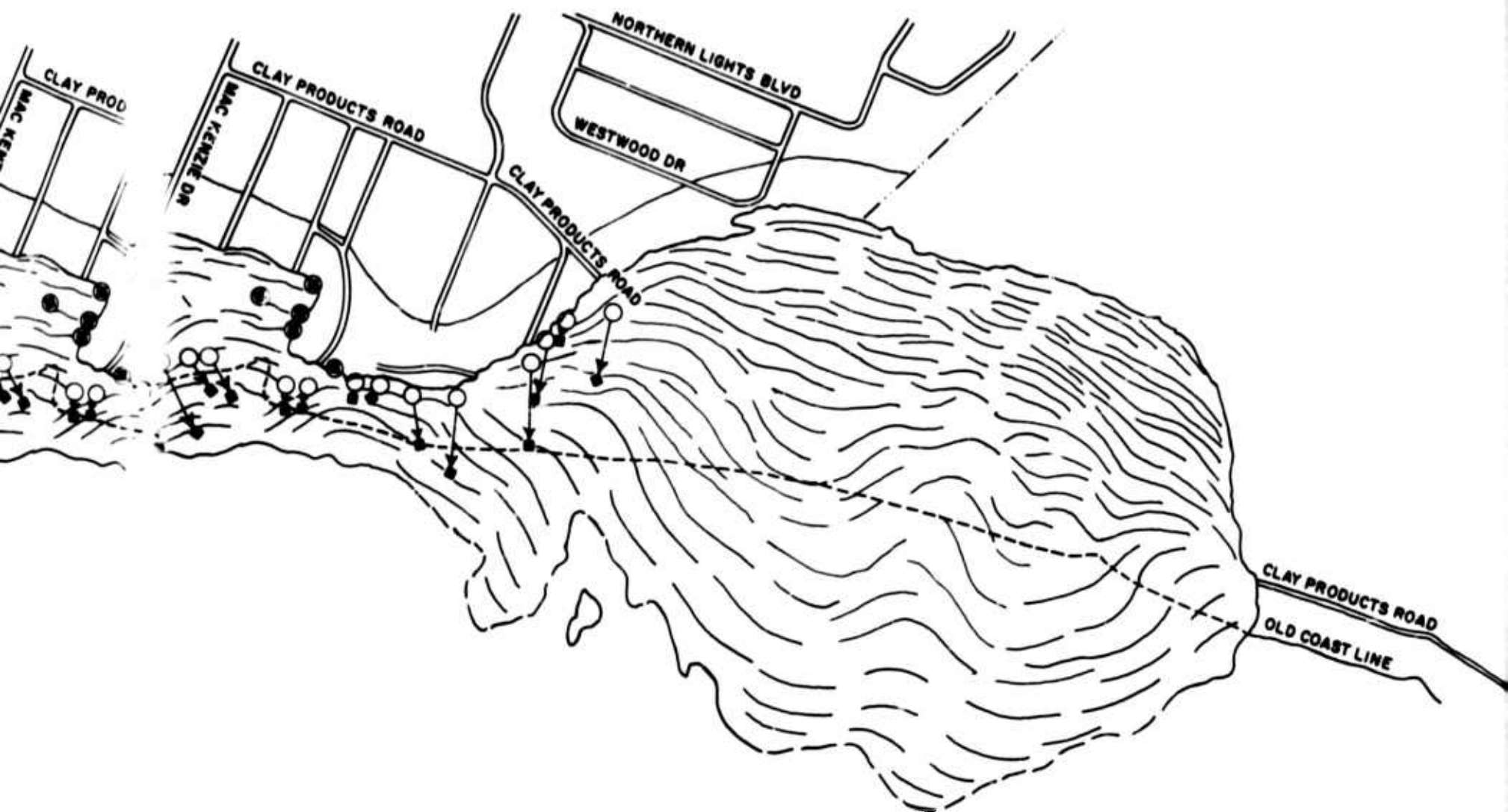




Figure 34. Turnagain Slide (Damage to residential buildings)

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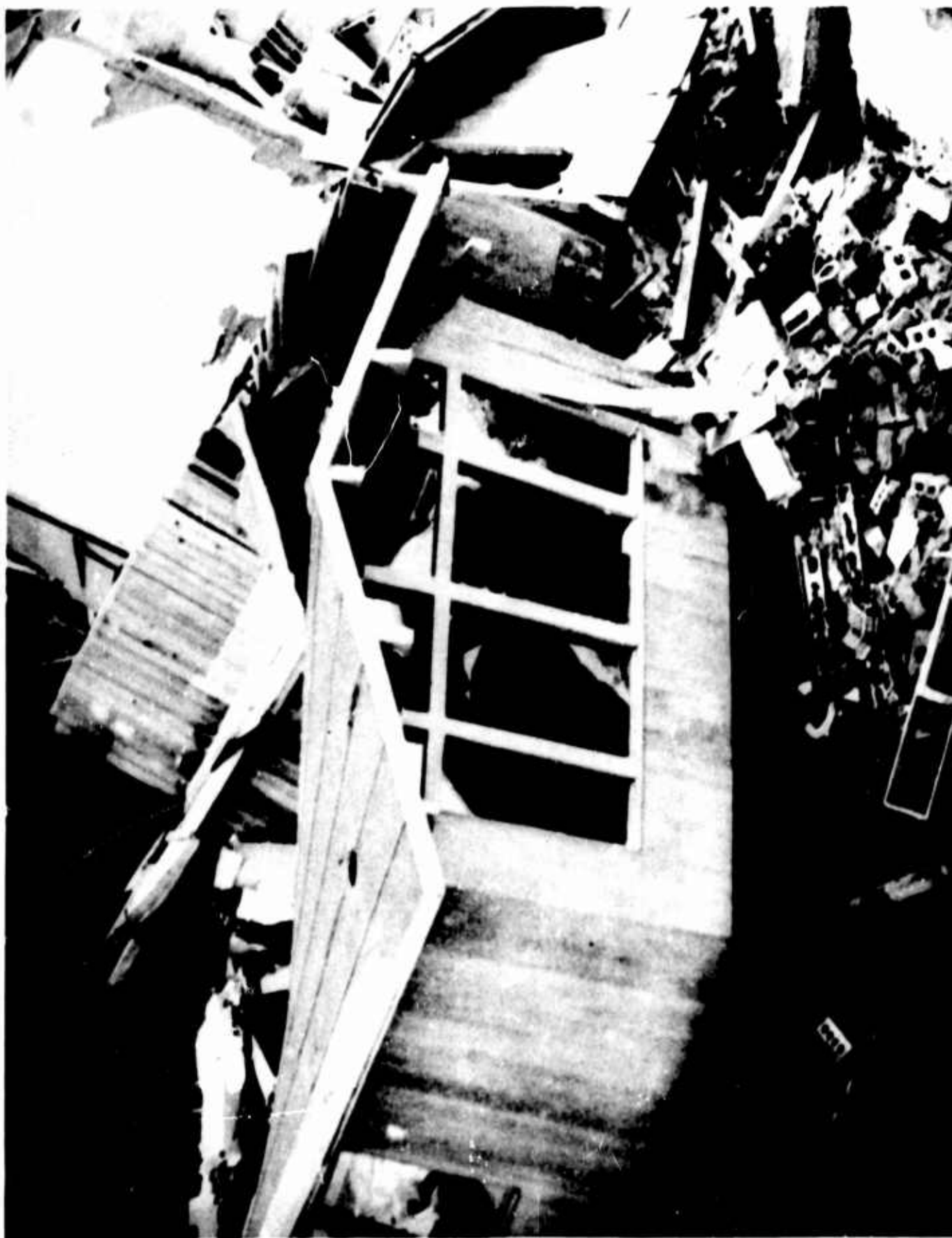


Figure 35. Turnagain Slide (Damage to residential buildings)

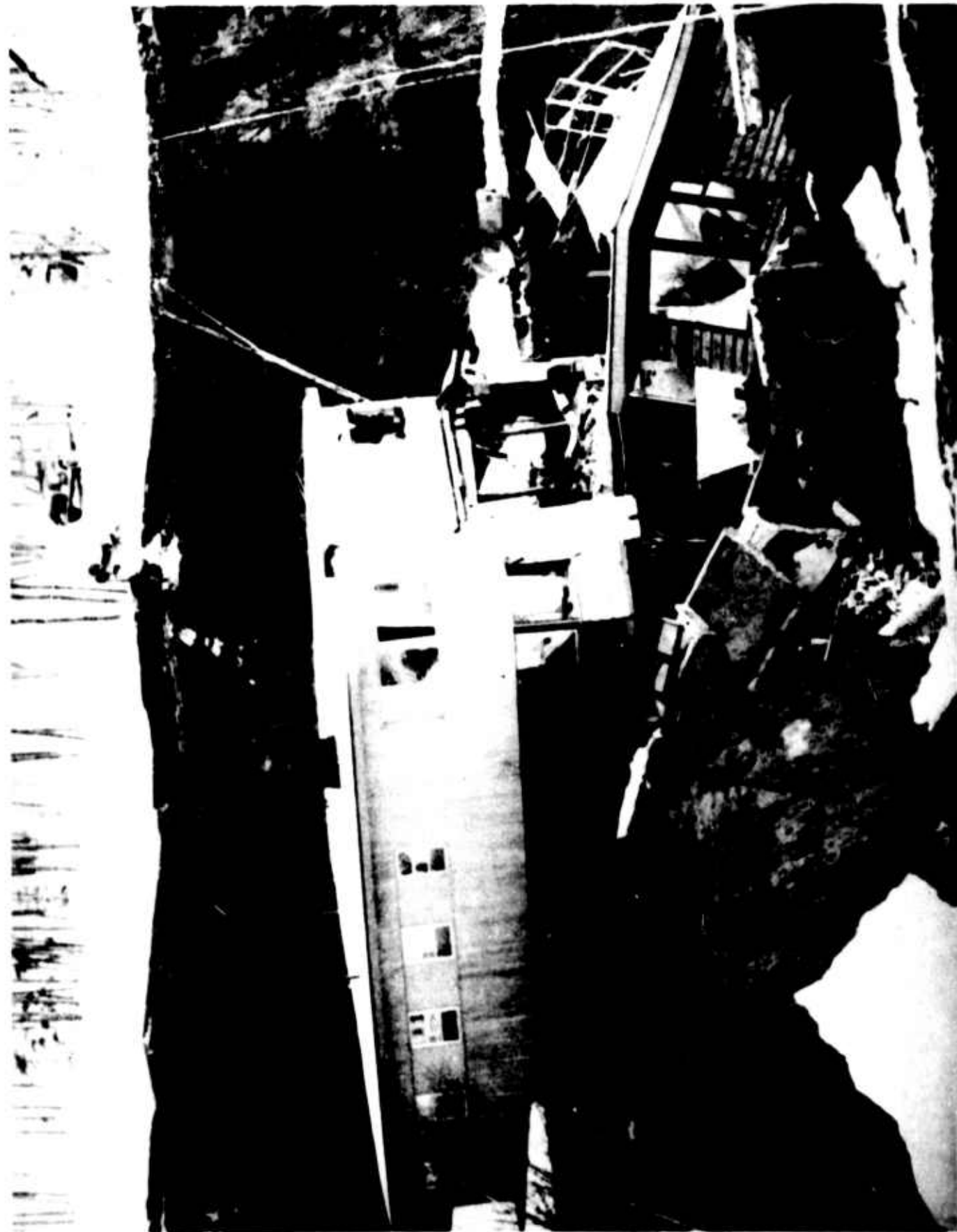


Figure 36. Turnagain Slide (Damage to residential buildings)



Figure 37. Turnagain Slide (Damage to residential buildings)

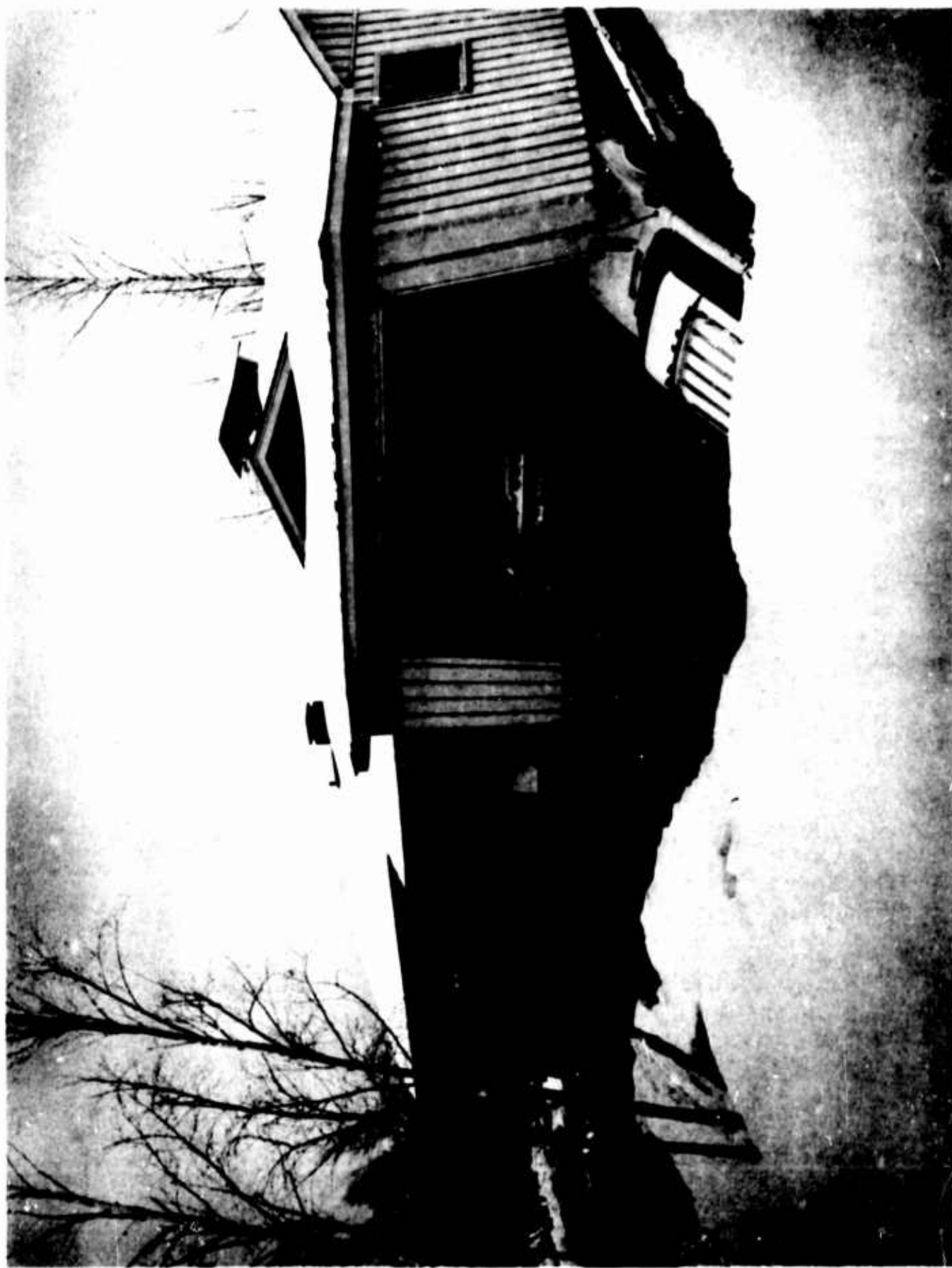


Figure 38. Turnagain Slide (Damage to residential buildings)



Figure 39. Turnagain Slide (Damage to residential buildings)



Figure 40. Turnagain Slide (Damage to residential buildings)

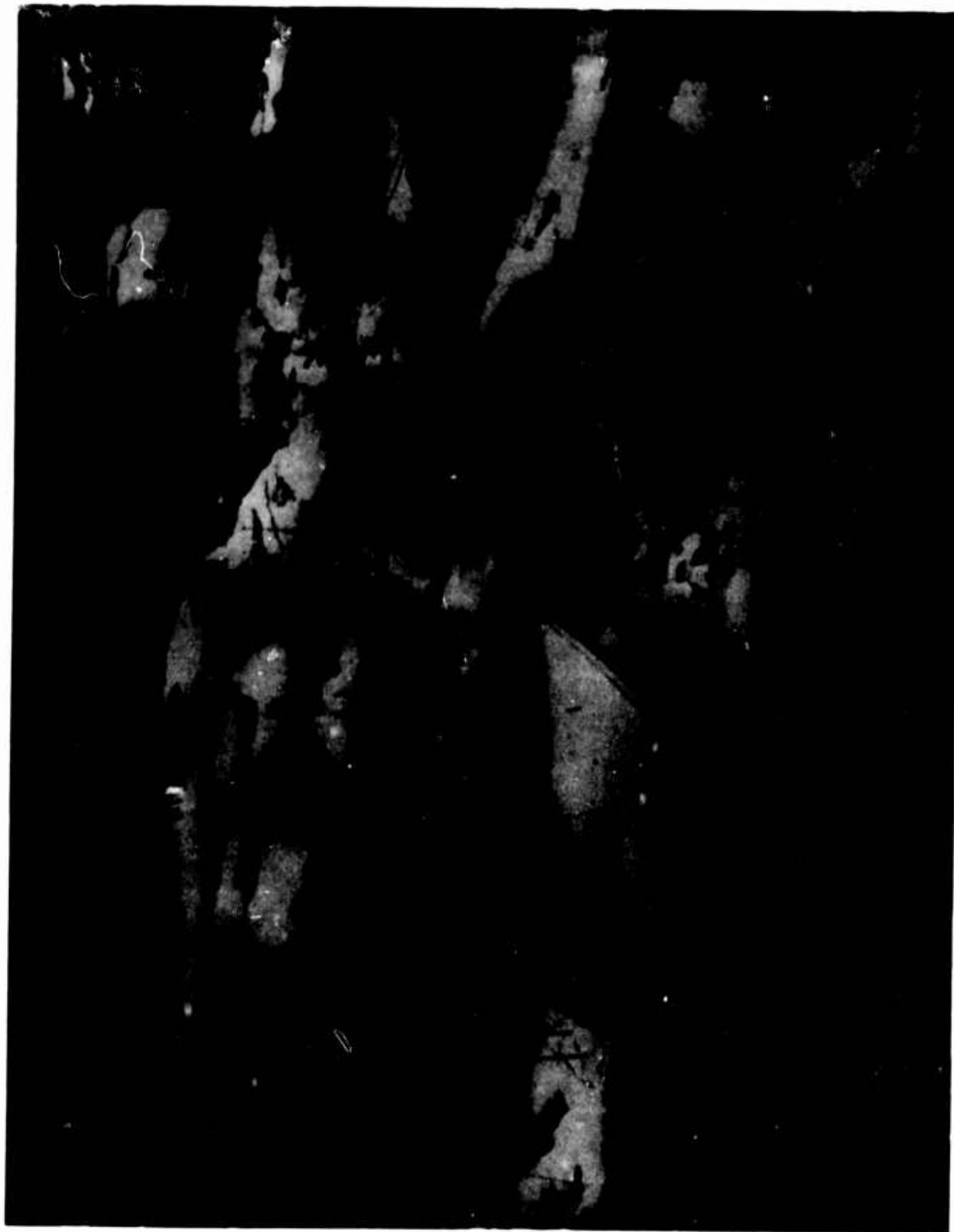


Figure 41. Turnagain Slide (Damage to residential buildings)



Figure 42. Turnagain Slide (Salvaging materials in anticipation of rebuilding)

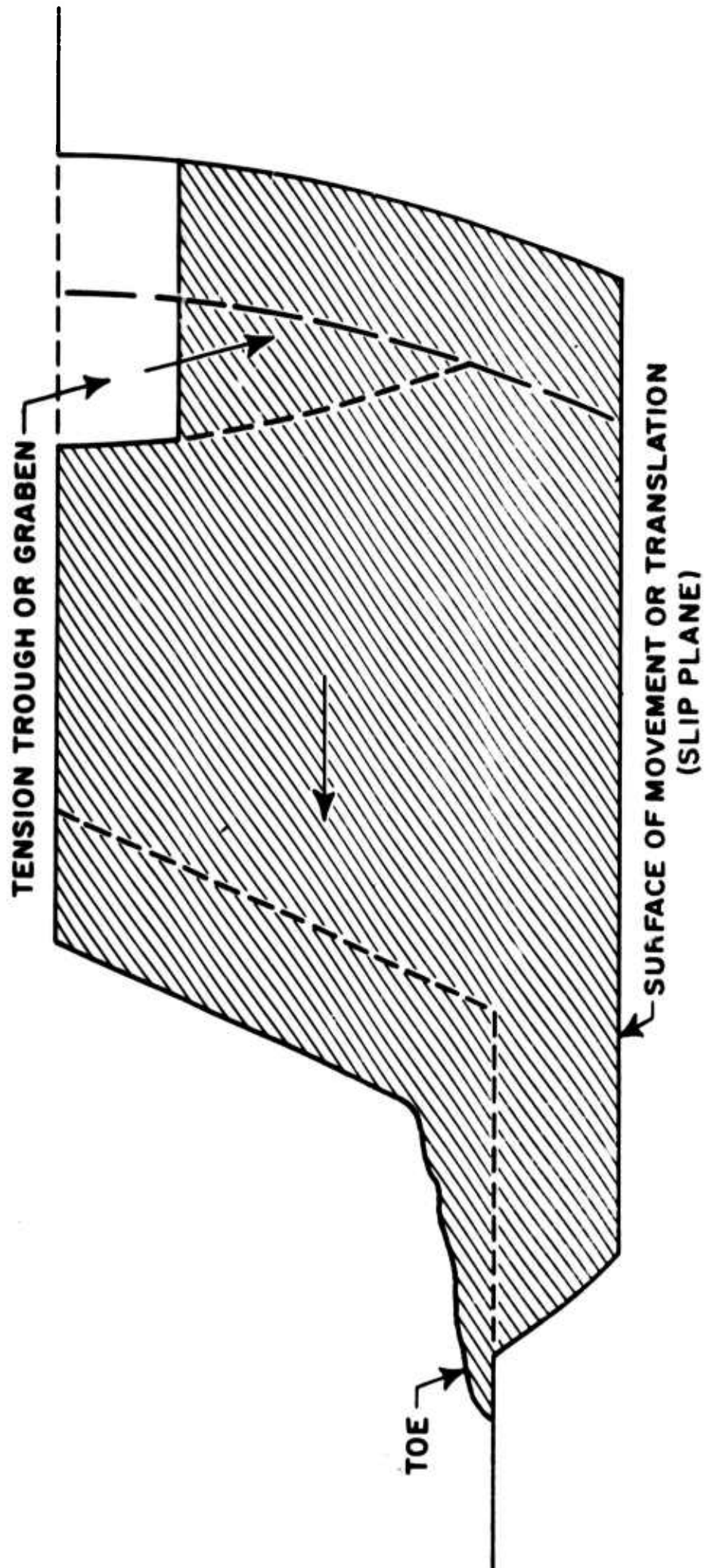


Figure 52. Idealized Slab-Type Landslide



Figure 44. Turnagain Slide (Toe of the west end of the slide, eroded by tidal action)



Figure 45. Turnagain Slide (Toe of the east end of the slide, eroded by tidal action)

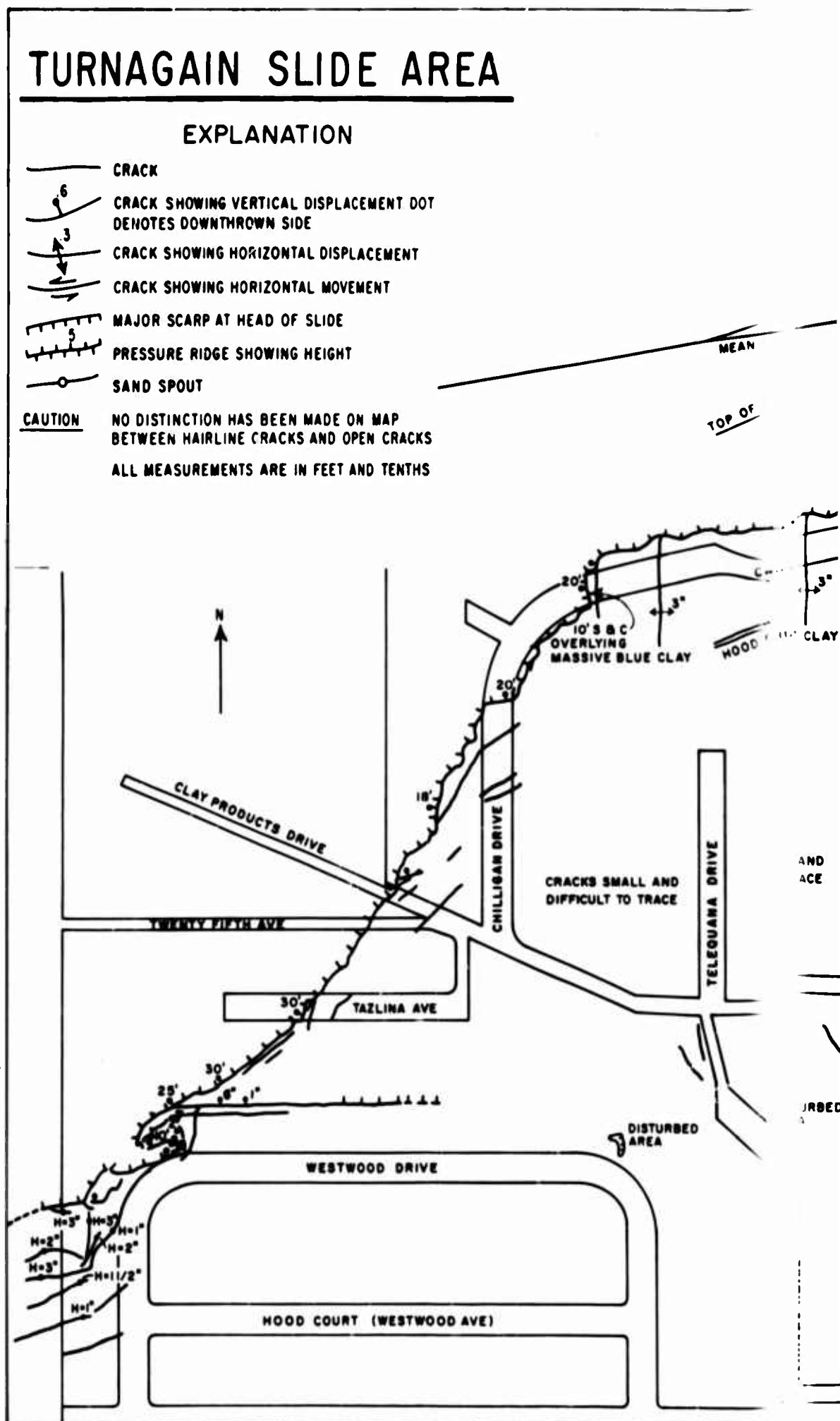


Figure 46a. Turnagain Slide (Representative: sen
ve:
(Source: Refe

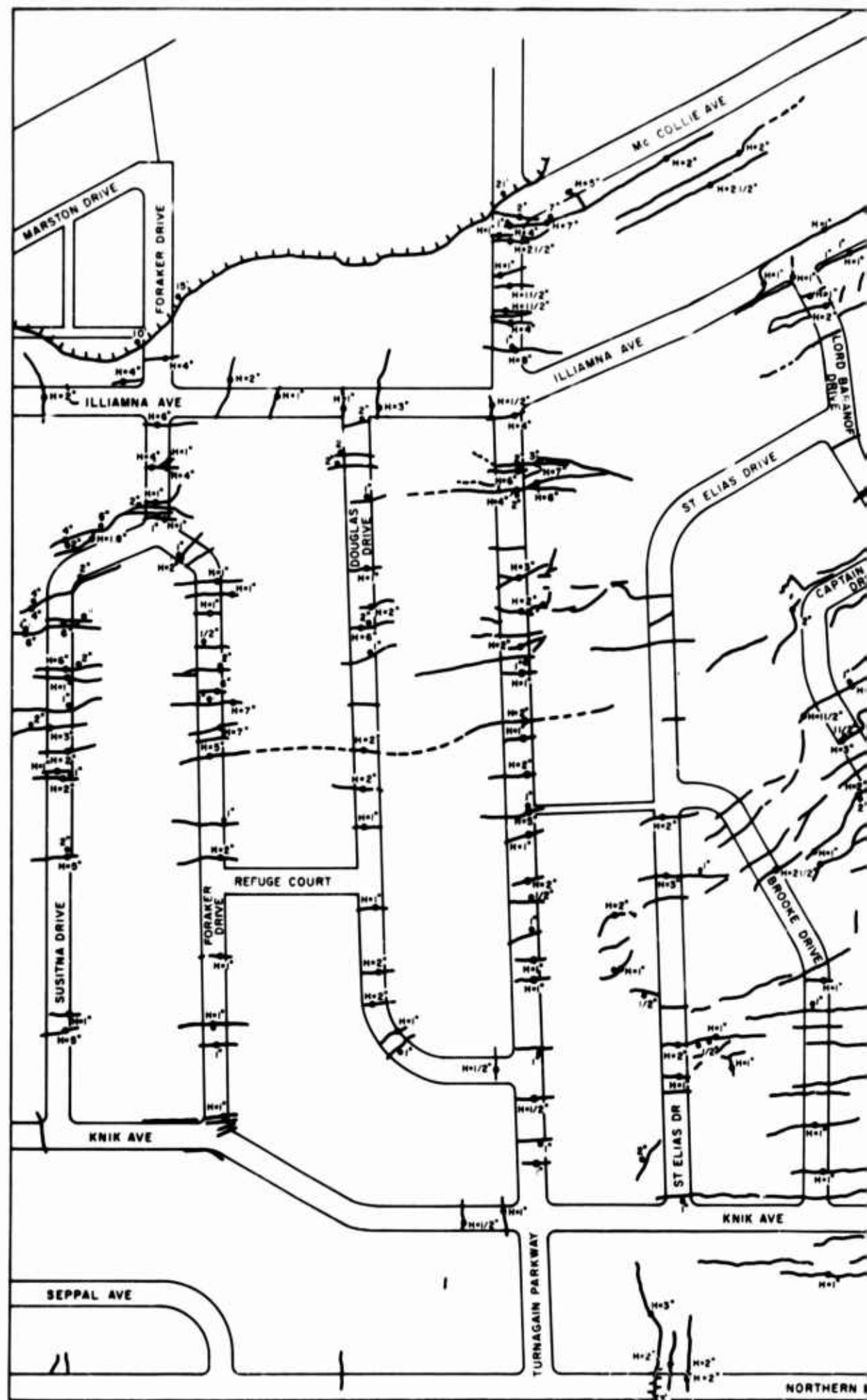


Figure 46b. Turnagain Slide (Representative fractures)
(Source: Reference VI)



Figure 47. Bluff Road Slide (Power plant, pumping station, and piping system after repairs)



Figure 49. Cherry Hill Slide (Top of the bluff)

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Figure 50. Cherry Hill Slide (Top of the bluff)



Figure 51. Romig Slide (Head of the slide northwest of West Anchorage High School)

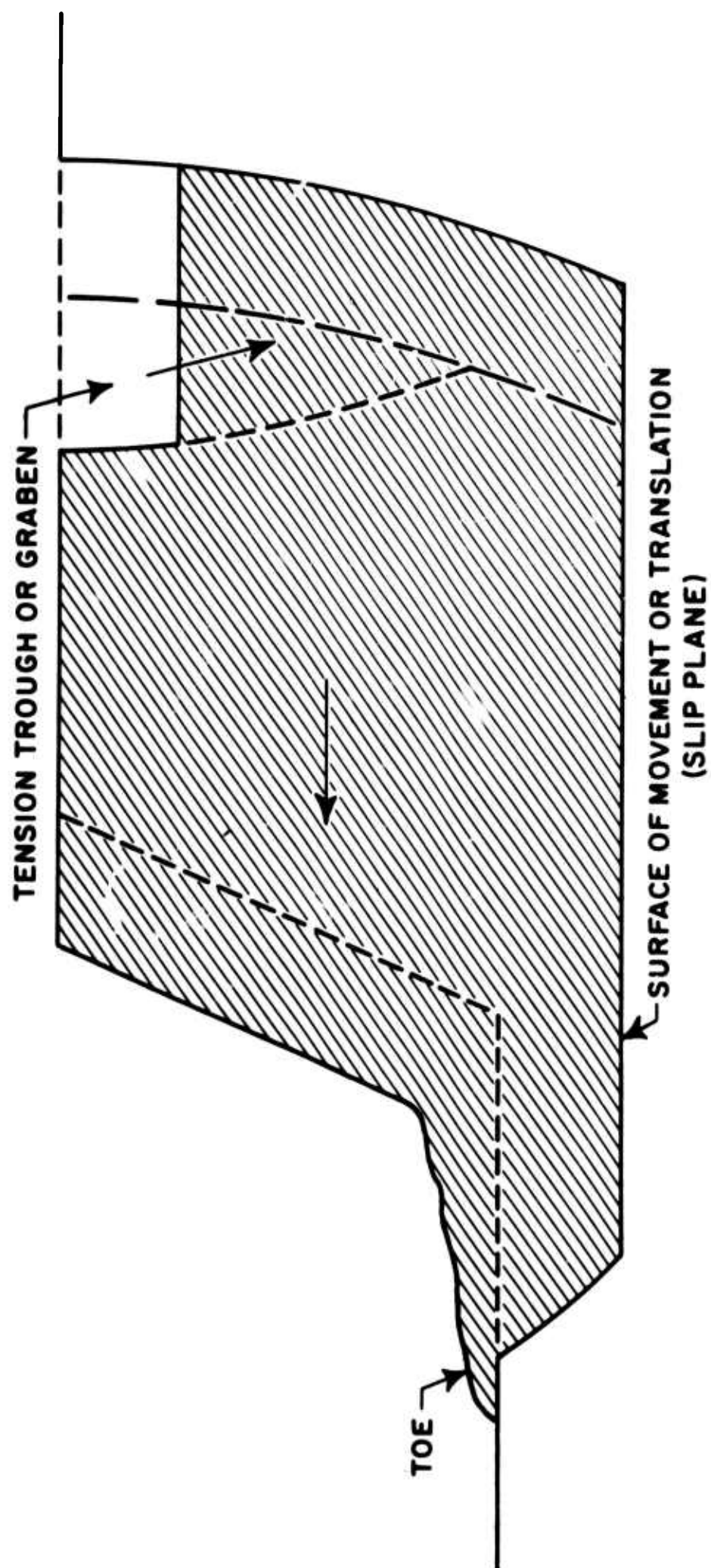
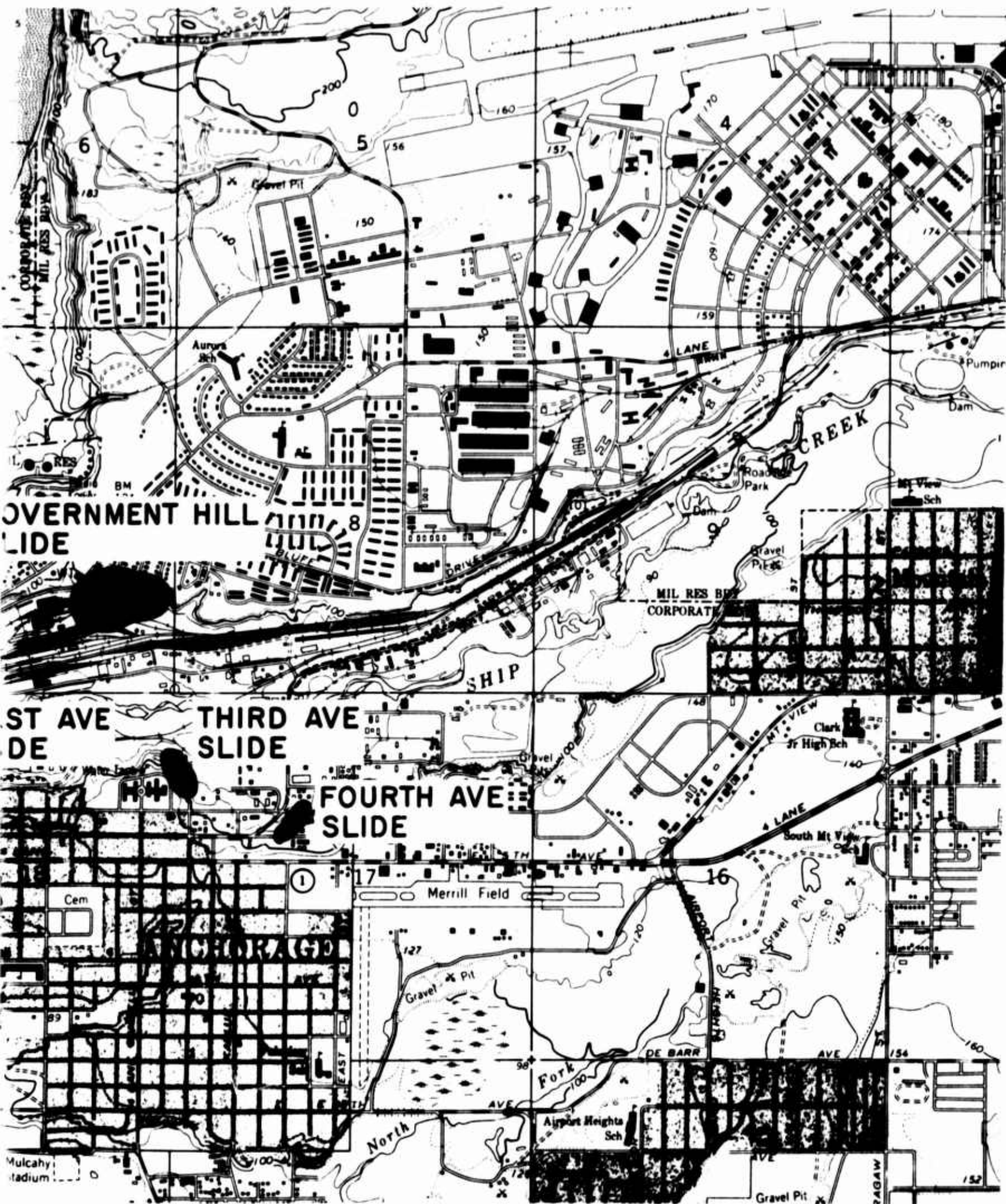


Figure 52. Idealized Slab-Type Landslide



Figure 53. Map of Anchorage (Showing locations of the three landslides: Government Slide, First Avenue Slide, and L Street Slide). (Source: Reference 1)

A



ations of the slab landslides triggered by the earthquake)
 ce: Reference IX-1)

B



Figure 54. Fourth Avenue Slide, Mosaic, Vertical Aerial Projection



Figure 55. Fourth Avenue Slide (Commodity warehouse in the terminal yard)



Figure 56. Fourth Avenue Slide
(Coca-Cola Bottling Company and Anchorage Cold Storage Company at First Avenue and C Street)

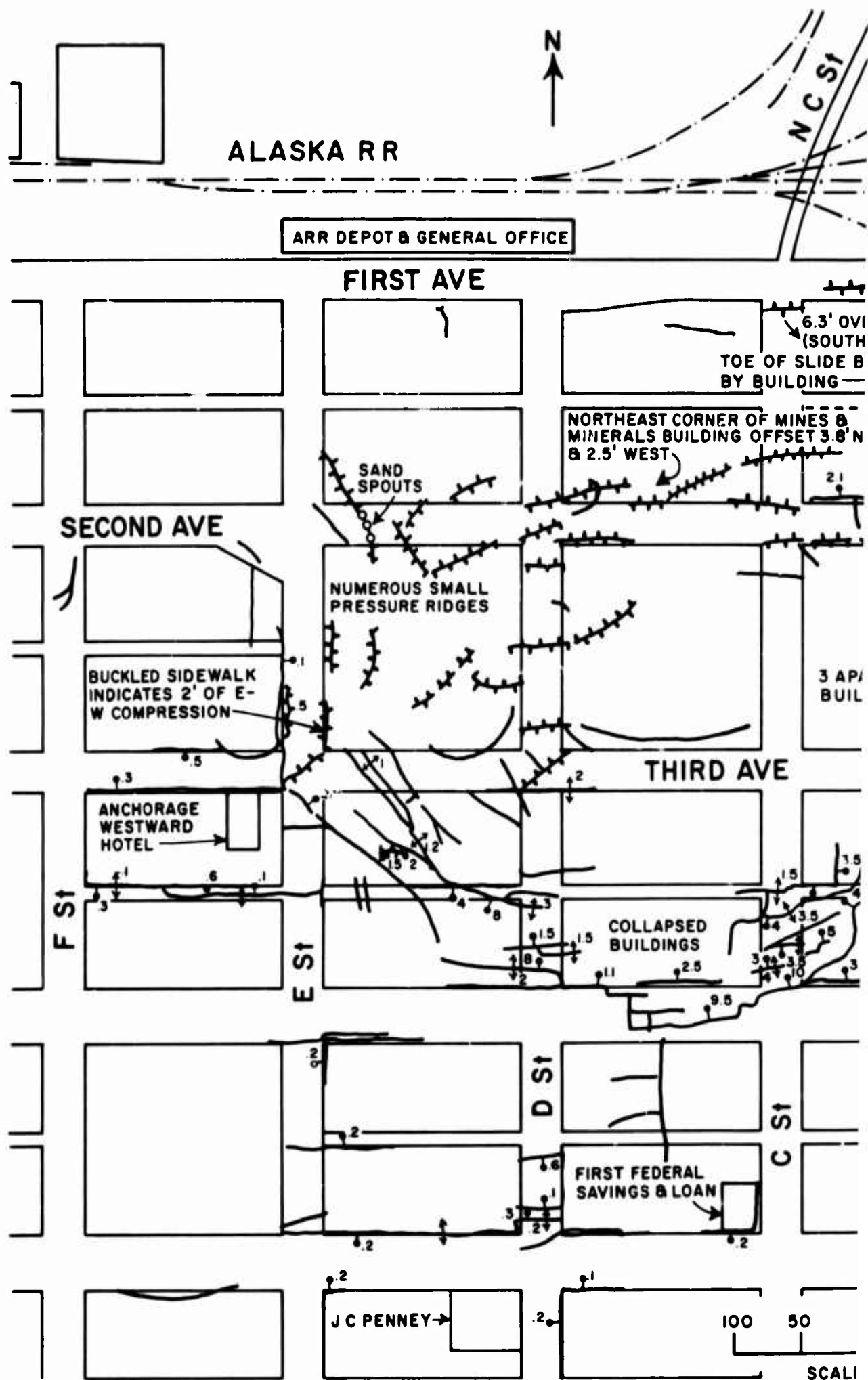
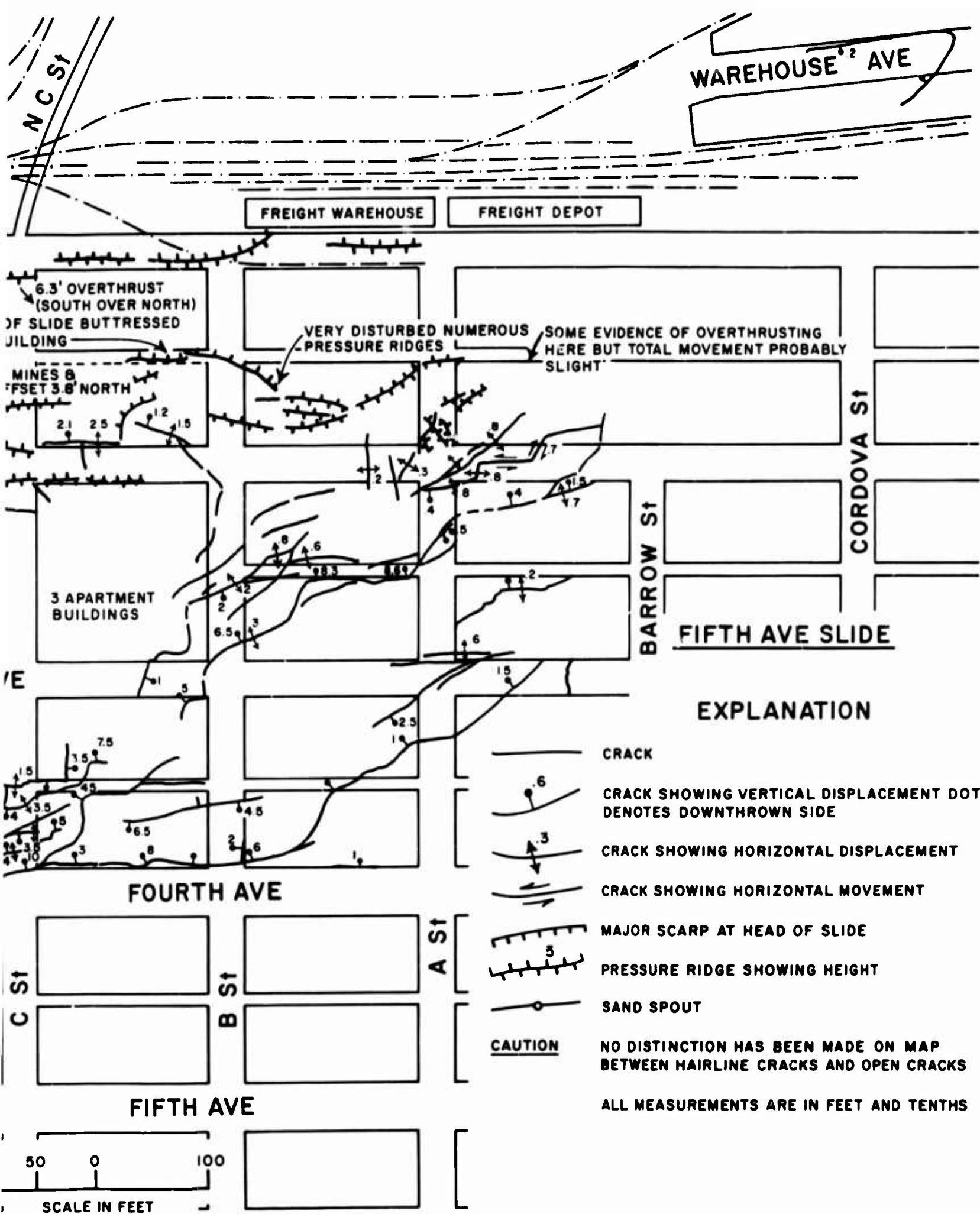


Figure 57. Fourth Avenue S
(Source: 1)

PRECEDING



Avenue Slide (Representative fractures)
Source: Reference IX-2)

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Figure 58. Fourth Avenue Slide
(Aerial view of damage to commercial buildings on the north side of Fourth Avenue)



Figure 59. Fourth Avenue Slide
(Aerial View of damage to commercial buildings on the north side of Fourth Avenue)

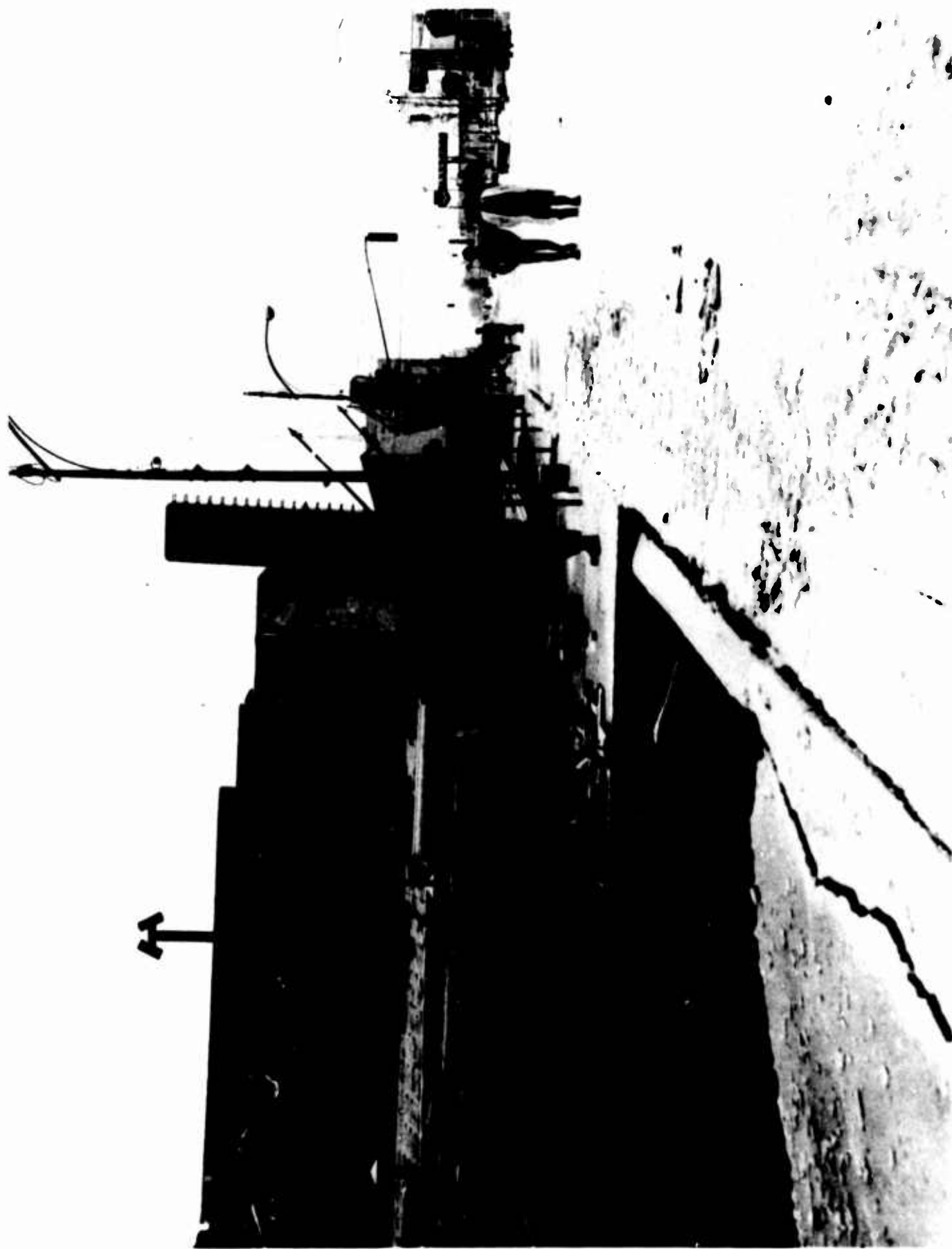


Figure 60. Fourth Avenue Slide (North side of Fourth Avenue between B and C Streets)



Figure 61. Fourth Avenue Slide (North side of Fourth Avenue between C and D Streets)



Figure 62. Fourth Avenue Slide (D Street north of Fourth Avenue)

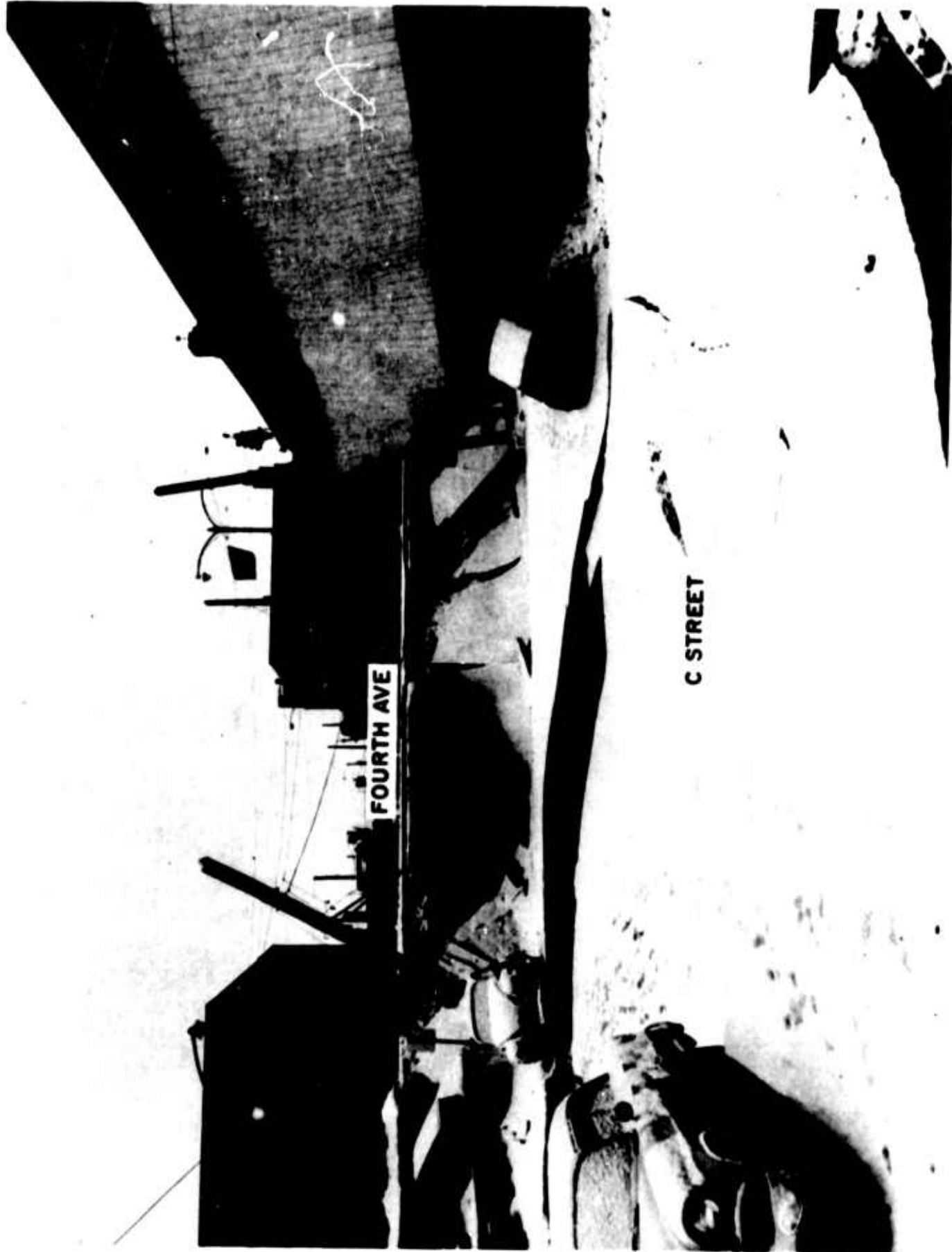


Figure 63. Fourth Avenue Slide (C Street north of Fourth Avenue)

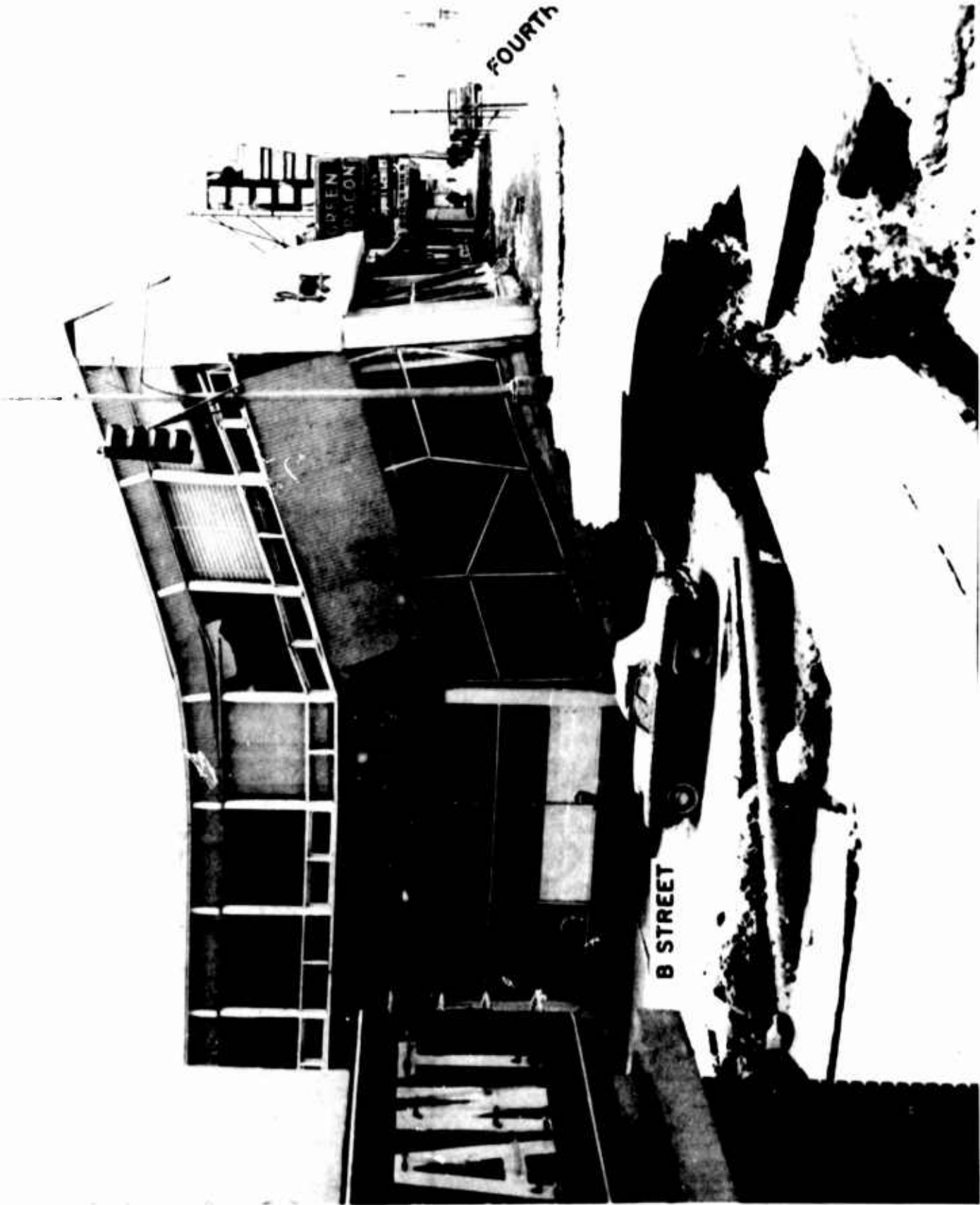


Figure 64. Fourth Avenue Slide (B Street and Fourth Avenue)



Figure 65. Fourth Avenue Slide (Damage to the E and F Apartments)

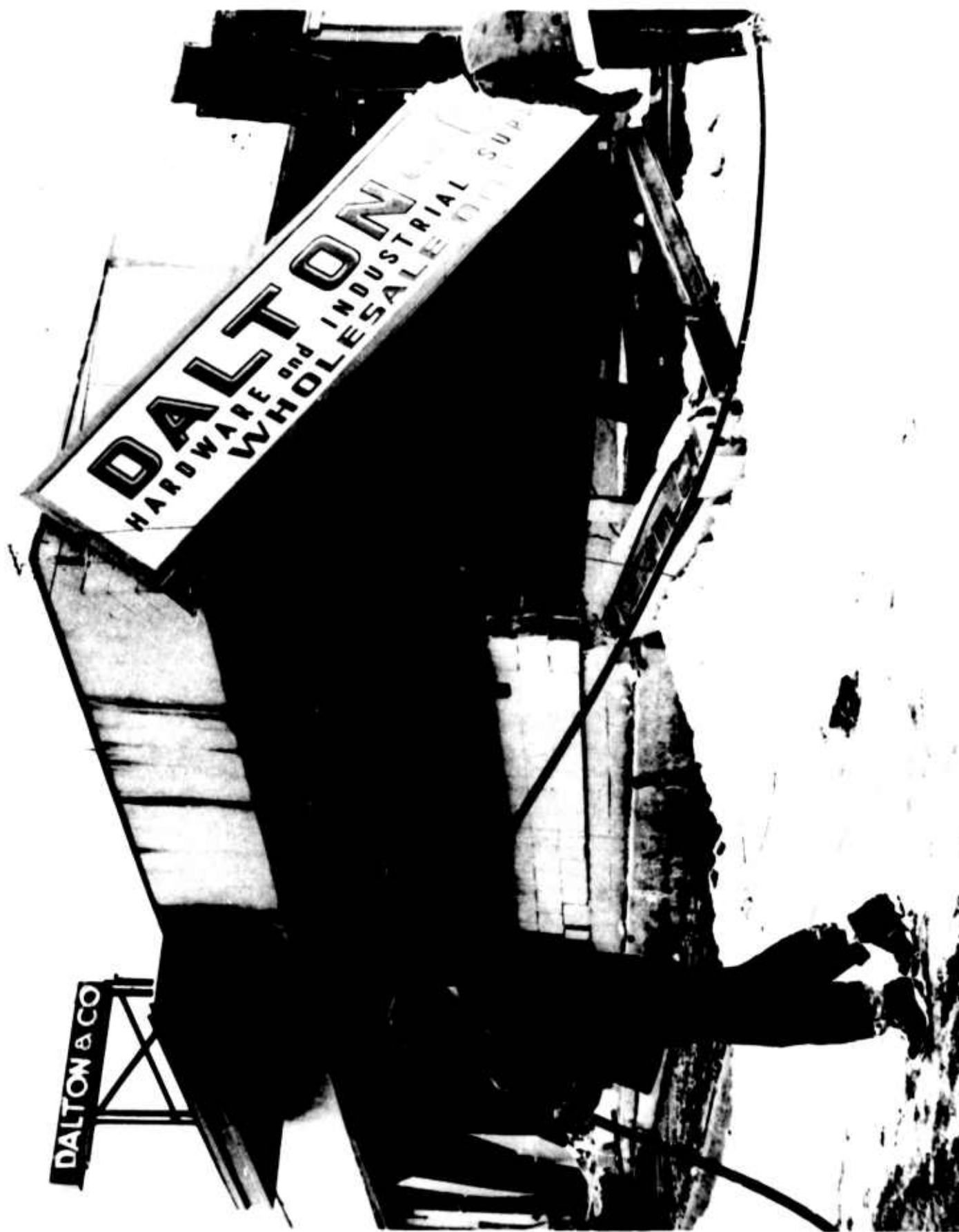


Figure 66. Fourth Avenue Slide (Dalton and Company building, destroyed by pressure ridge north of Second Street)



Figure 67. Fourth Avenue Slide (Displacement of Third Avenue between C and E Streets)

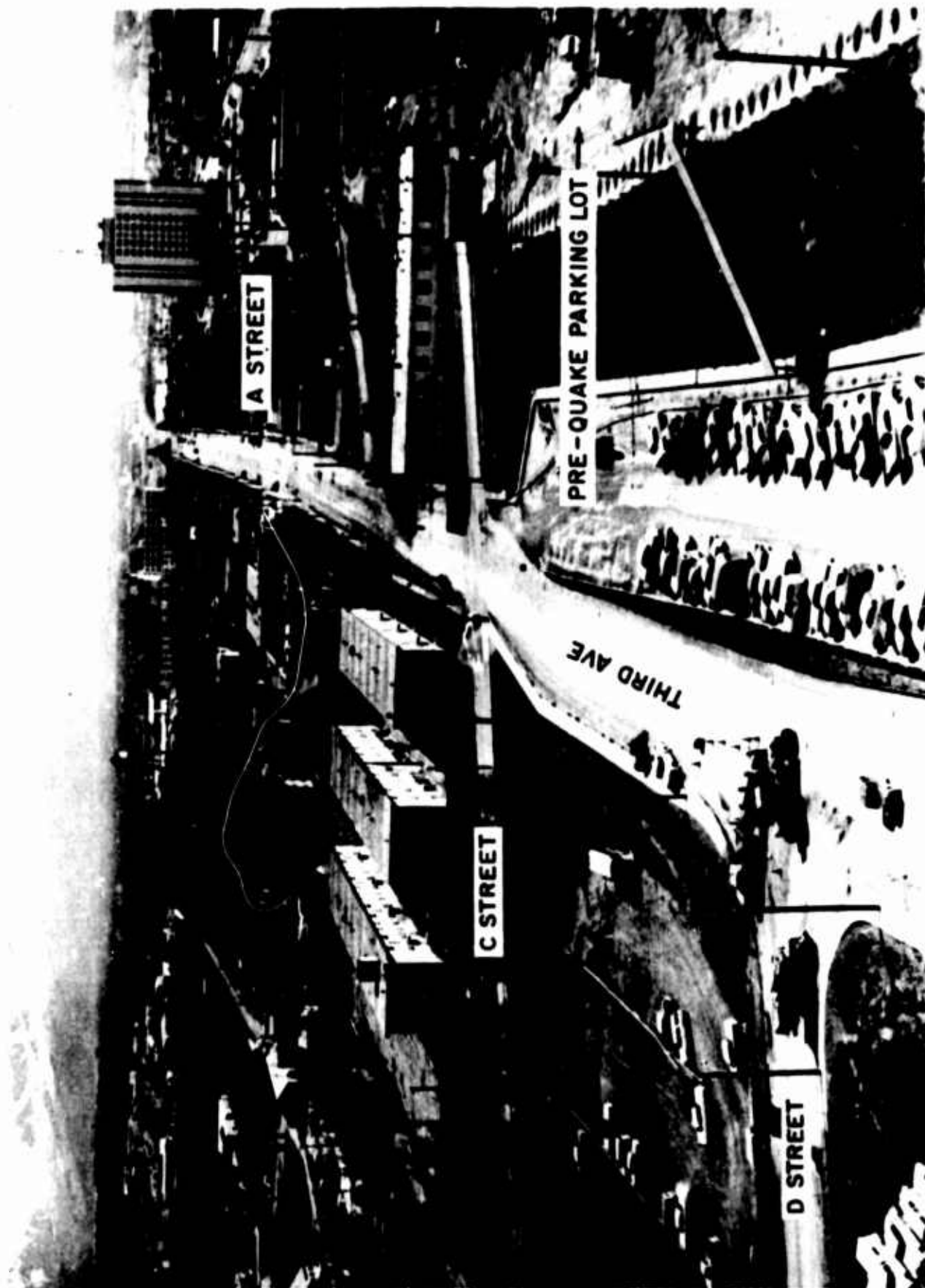


Figure 68. Fourth Avenue Slide (Displacement of Third Avenue between A and C Streets)



Figure 69. Fourth Avenue Slide (Uncracked window glass)

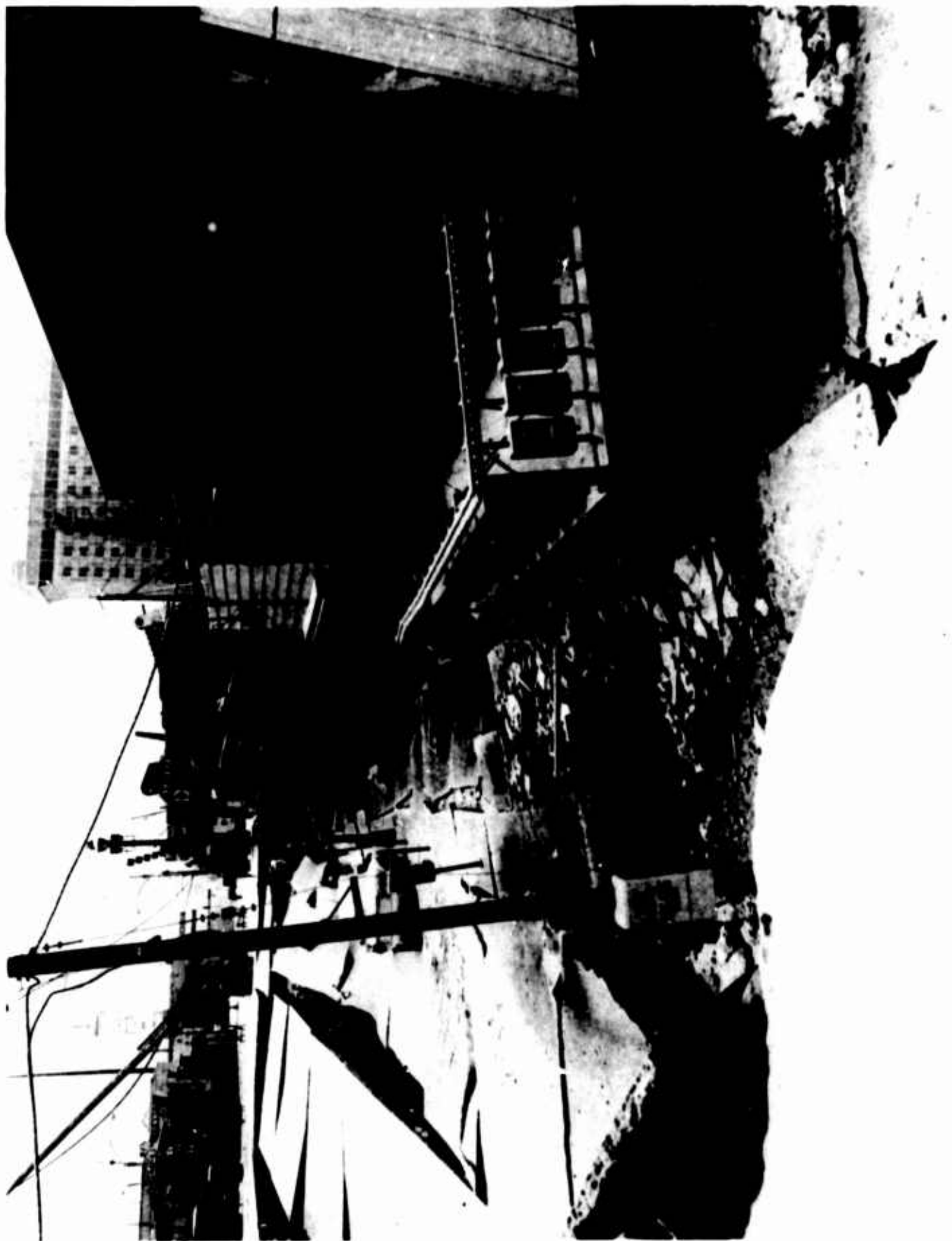


Figure 70. Fourth Avenue Slide (Unbroken light bulbs in the Arcade marquee)



Figure 71. Fourth Avenue Slide (Incipient graben on D Street just north of Fifth Avenue)

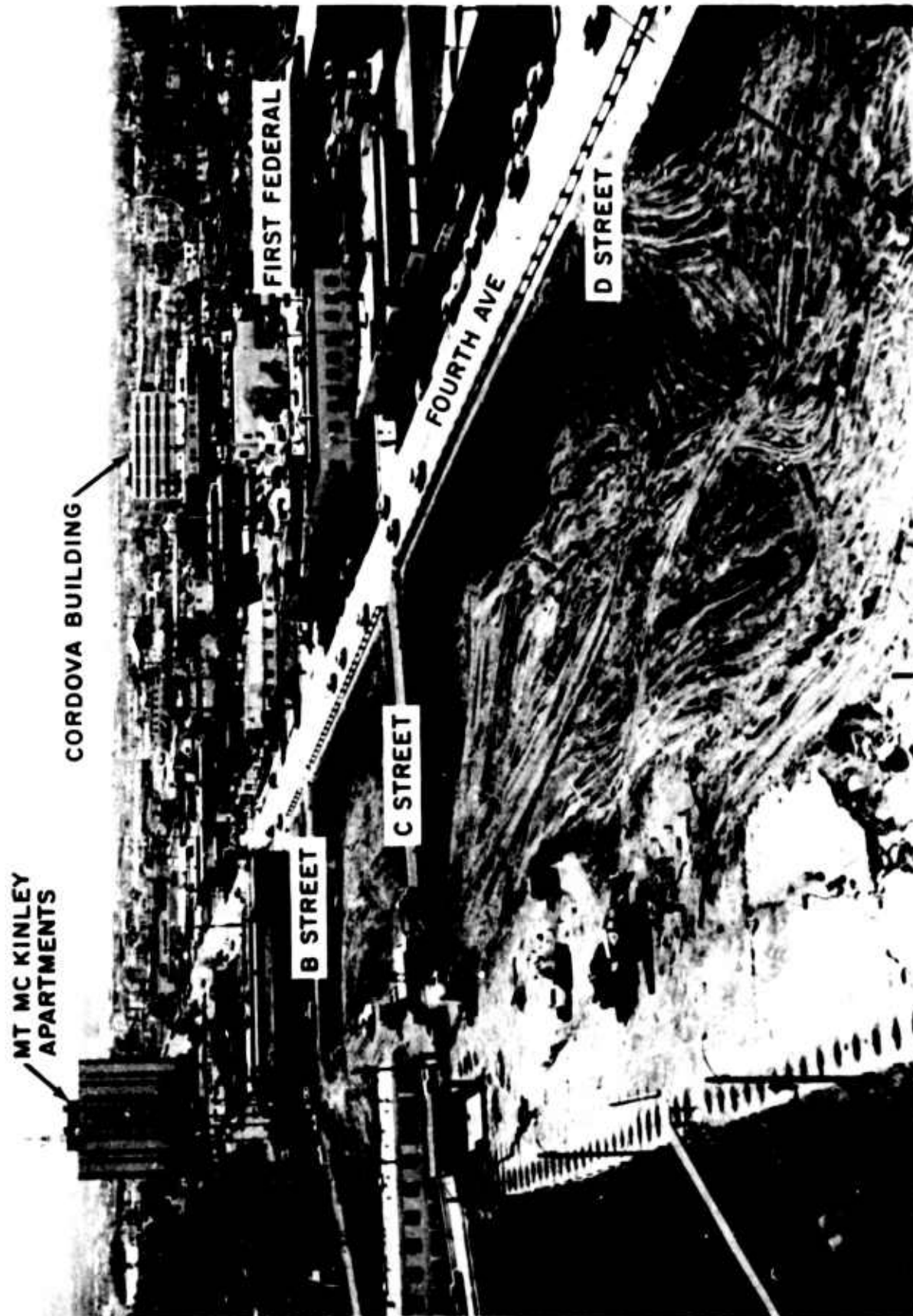


Figure 72. Fourth Avenue Slide (Fourth Avenue between B and D Streets after demolition)

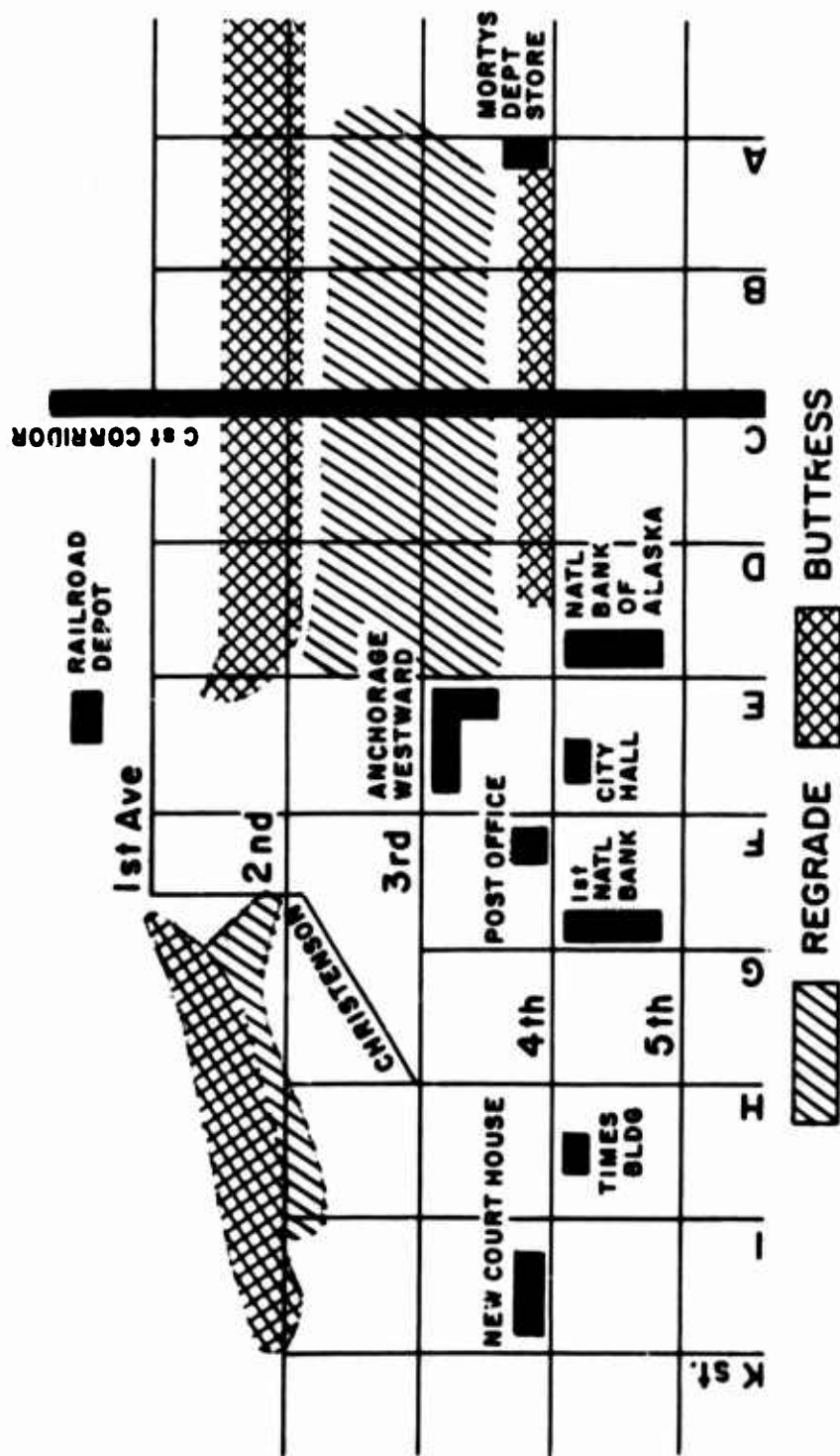


Figure 73. Fourth Avenue Slide (Stabilization program) (Source: Reference IX-9)







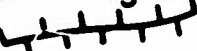
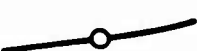

Figure 74. L Street Slide, Mosaic, Vertical Aerial Projection



Figure 75. L Street Slide (Residence at 821 N Street)

"L" STREET SLIDE

EXPLANATION

-  CRACK
-  CRACK SHOWING VERTICAL DISPLACEMENT. DOT DENOTES DOWNTOWN SIDE
-  CRACK SHOWING HORIZONTAL DISPLACEMENT
-  CRACK SHOWING HORIZONTAL MOVEMENT
-  MAJOR SCARP AT HEAD OF SLIDE
-  PRESSURE RIDGE SHOWING HEIGHT
-  SAND SPOUT

CAUTION

NO DISTINCTION HAS BEEN MADE ON MAP
BETWEEN HAIRLINE CRACKS AND OPEN CRACKS

ALL MEASUREMENTS ARE IN FEET AND TENTHS

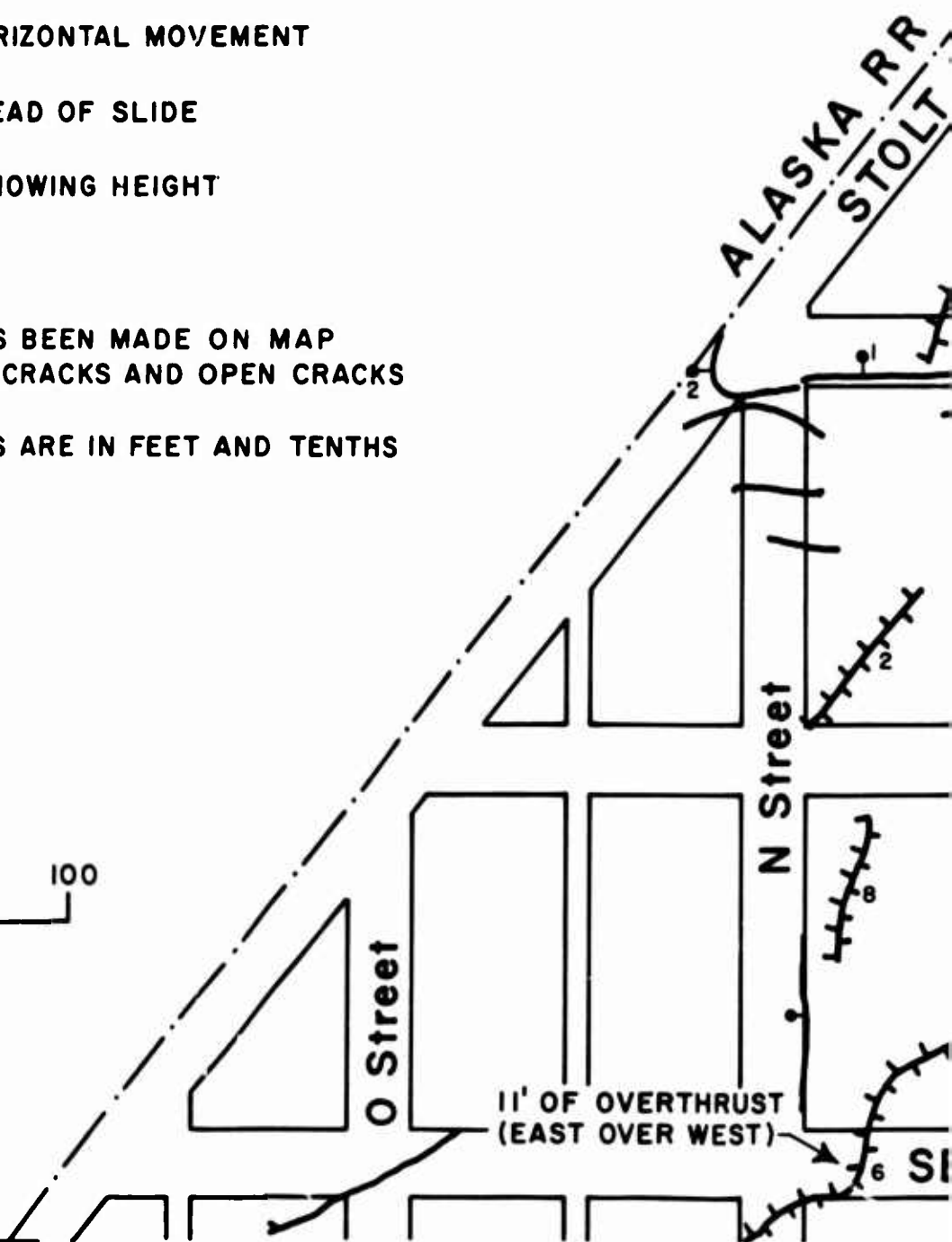
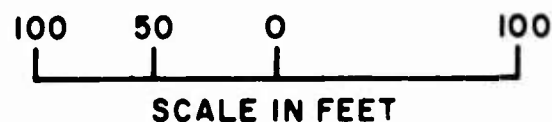


Figure 76b. L Street Slide (Preliminary geologic mapping)
(Source: Reference IX-2)



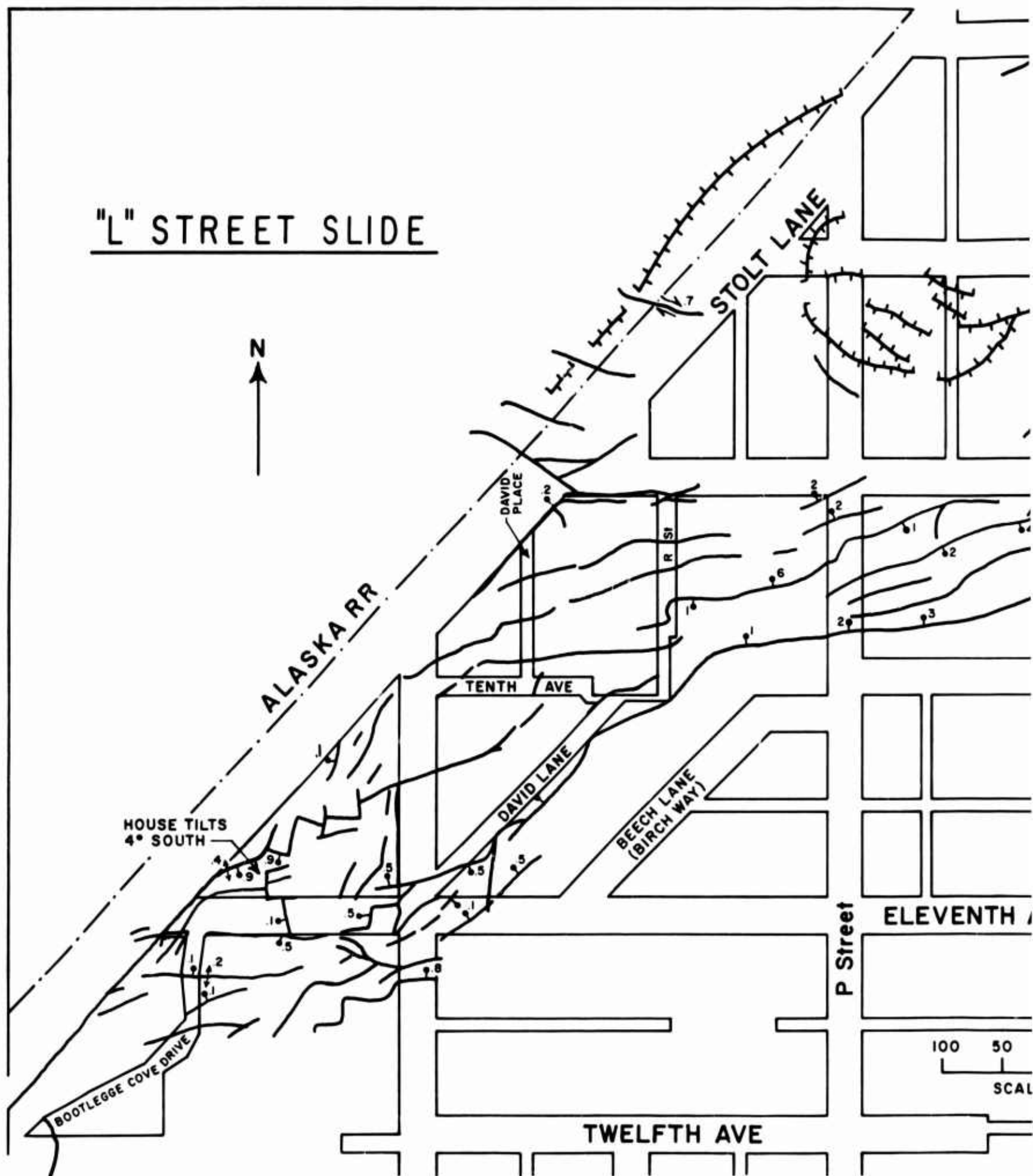
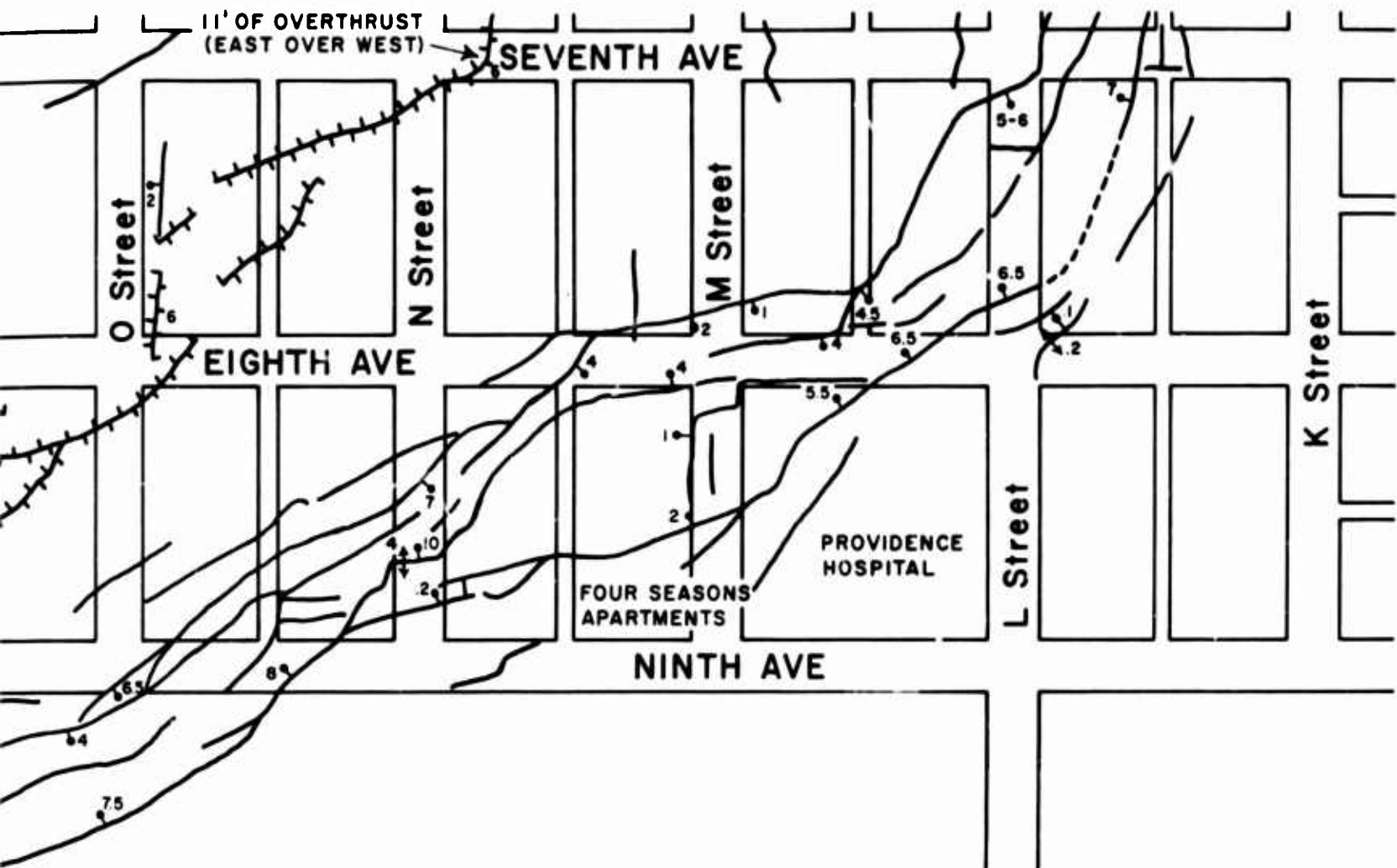


Figure 76a. L Street Slide (Preliminary geology)
(Source: Reference)



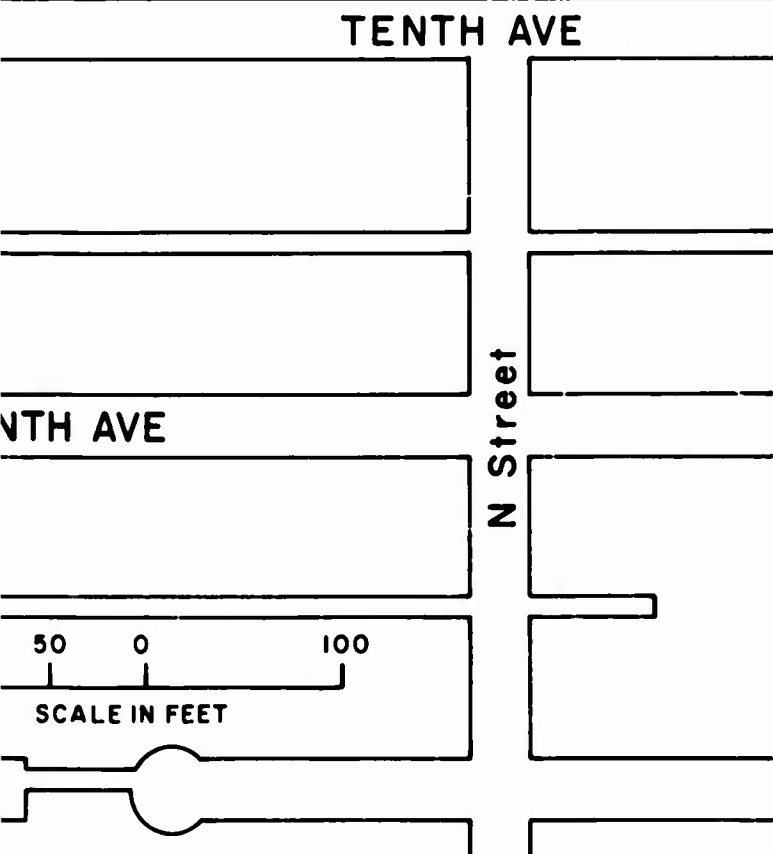
EXPLANATION

- CRACK
- 6 — CRACK SHOWING VERTICAL DISPLACEMENT. DOT DENOTES DOWNTHROWN SIDE
- 3 — CRACK SHOWING HORIZONTAL DISPLACEMENT
- CRACK SHOWING HORIZONTAL MOVEMENT
- MAJOR SCARP AT HEAD OF SLIDE
- 5 — PRESSURE RIDGE SHOWING HEIGHT
- SAND SPOUT

CAUTION

NO DISTINCTION HAS BEEN MADE ON MAP BETWEEN HAIRLINE CRACKS AND OPEN CRACKS

ALL MEASUREMENTS ARE IN FEET AND TENTHS



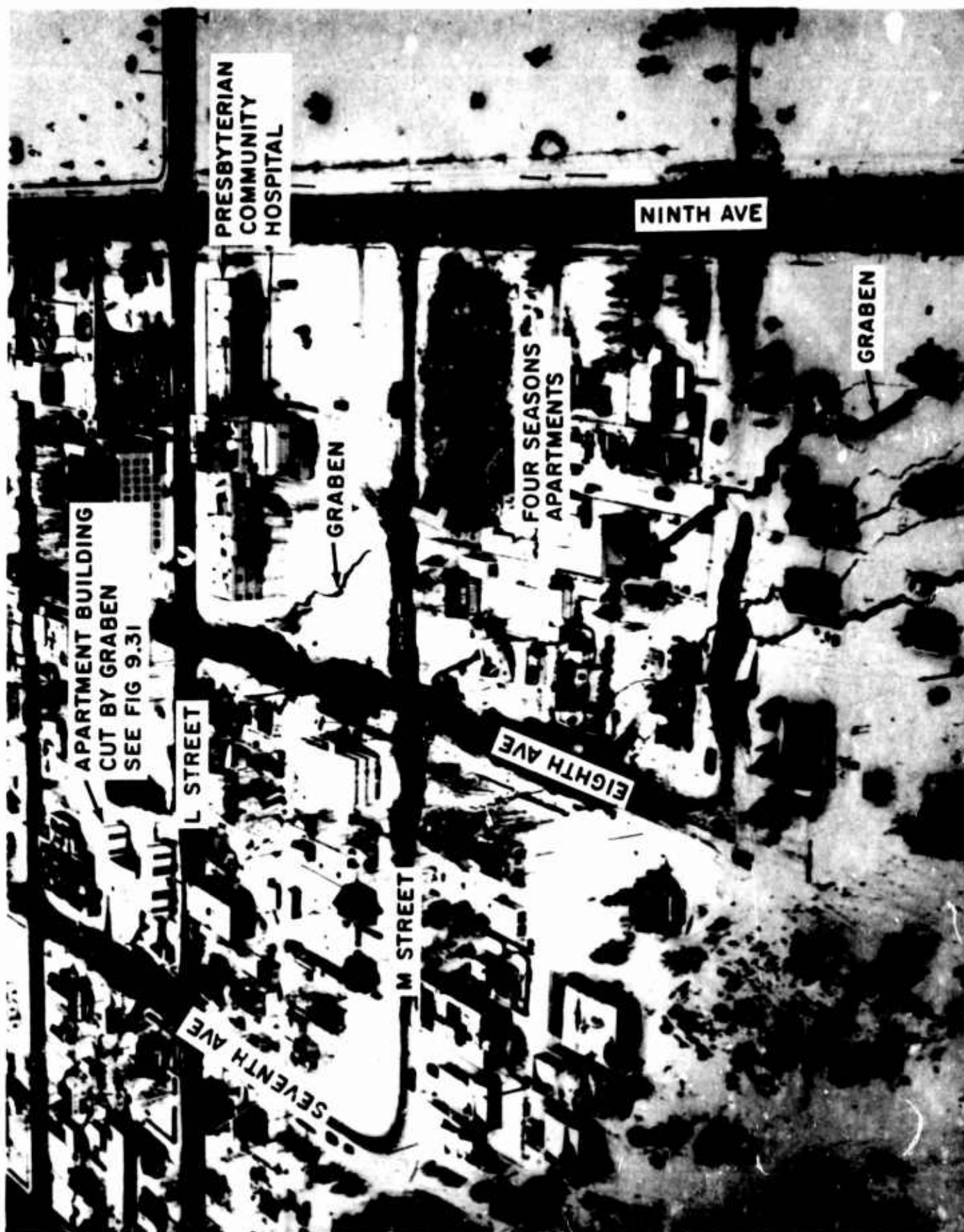


Figure 77. L Street Slide (Four Seasons Apartments)



Figure 78. L Street Slide (Four Seasons Apartments)



Figure 79. L Street Slide (Residence on Eights Avenue between M and N Streets)



Figure 80. L Street Slide (Residence at Eighth Avenue and N Street)

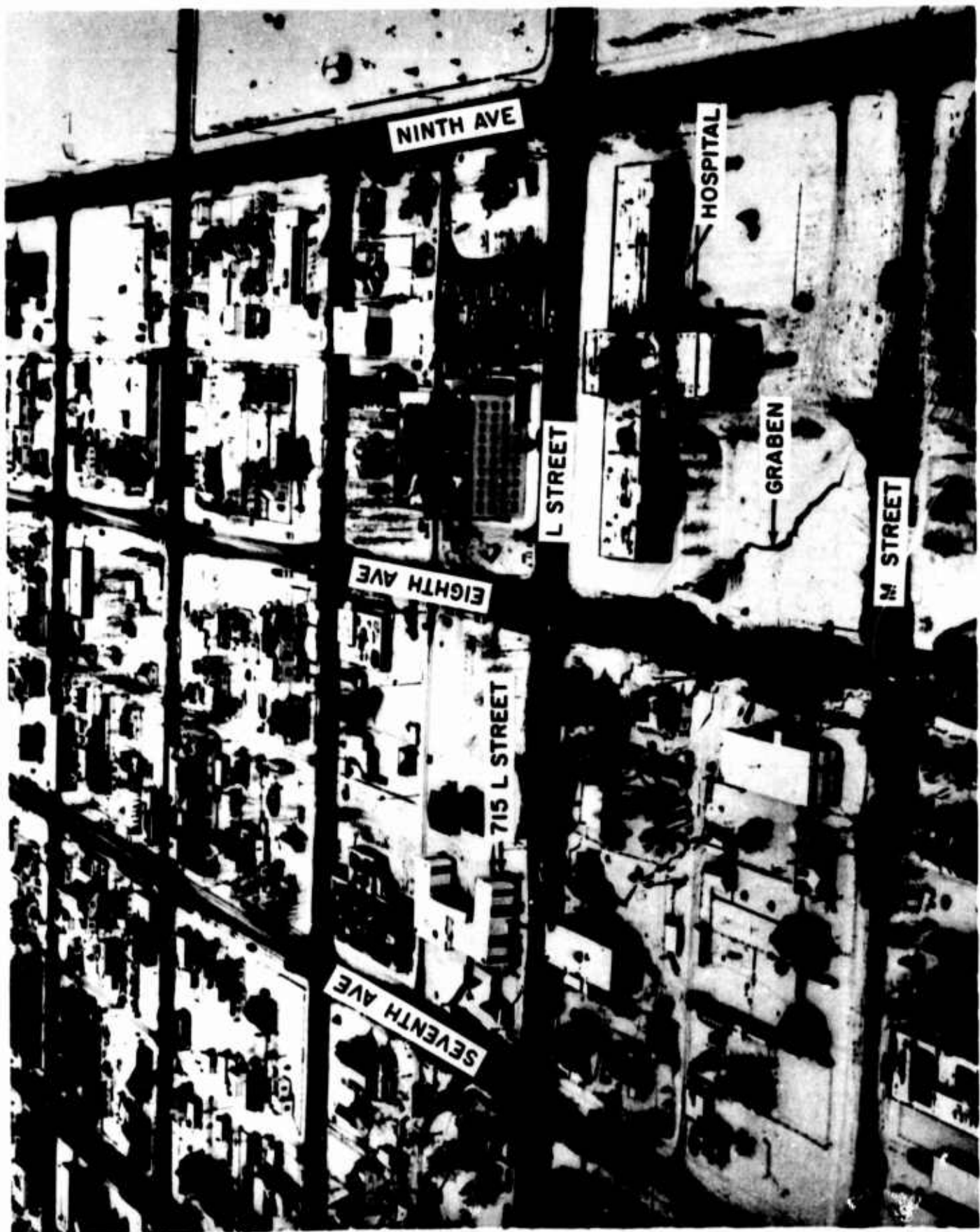


Figure 81. L Street Slide (Aerial view of apartment building at 715 L Street)

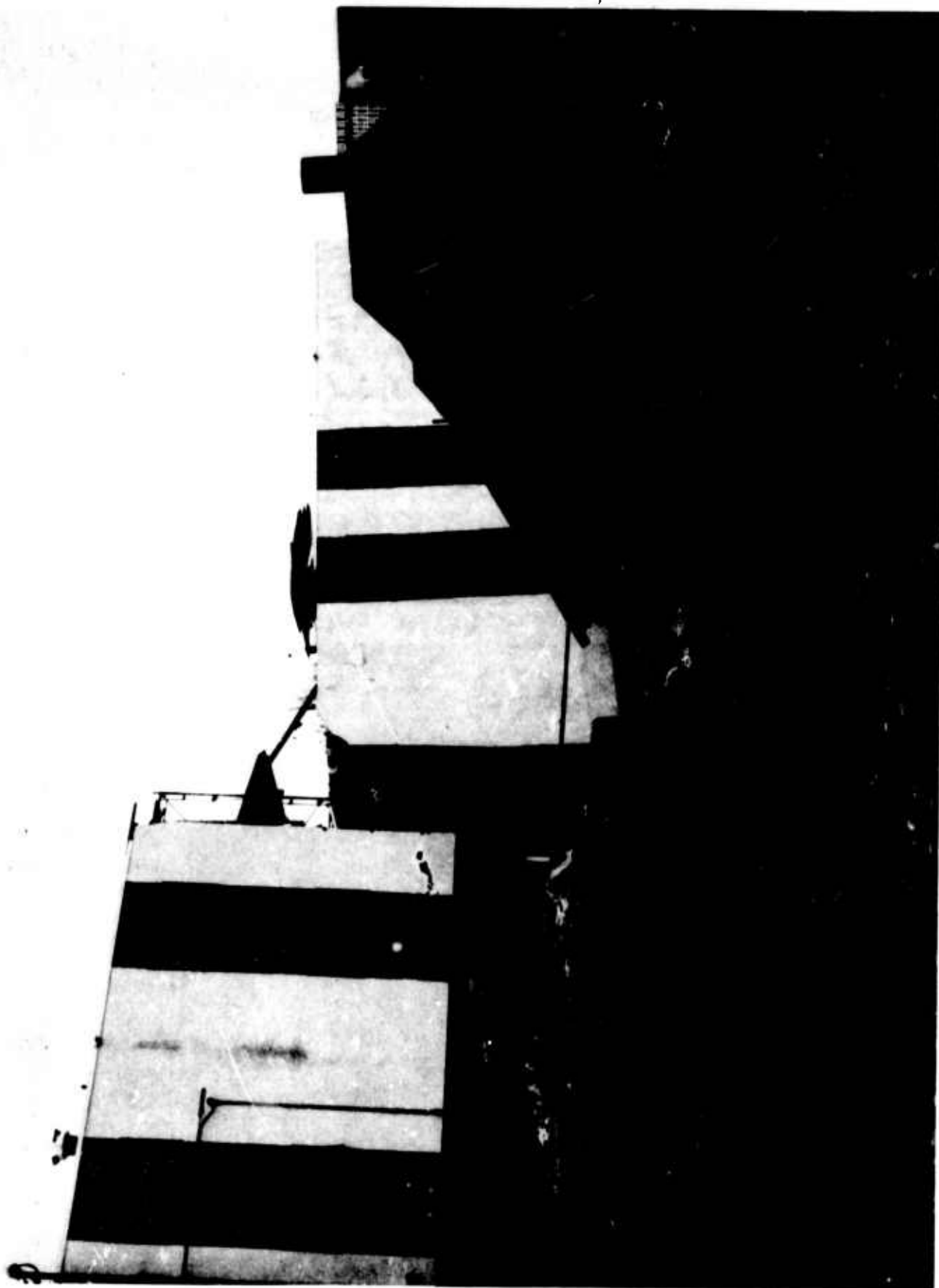


Figure 82. L Street Slide (Fracture and displacement of the apartment building at 715 L Street)



Figure 83. L Street Slide (Northern end of graben, paralleling K Street)



Figure 84. L Street Slide (Commercial building at Sixth Avenue and K Street)



Figure 85. L Street Slide (Residence at Fifth Avenue and K Street)



Figure 86. L Street Slide (Residence at Fifth Avenue and K Street)

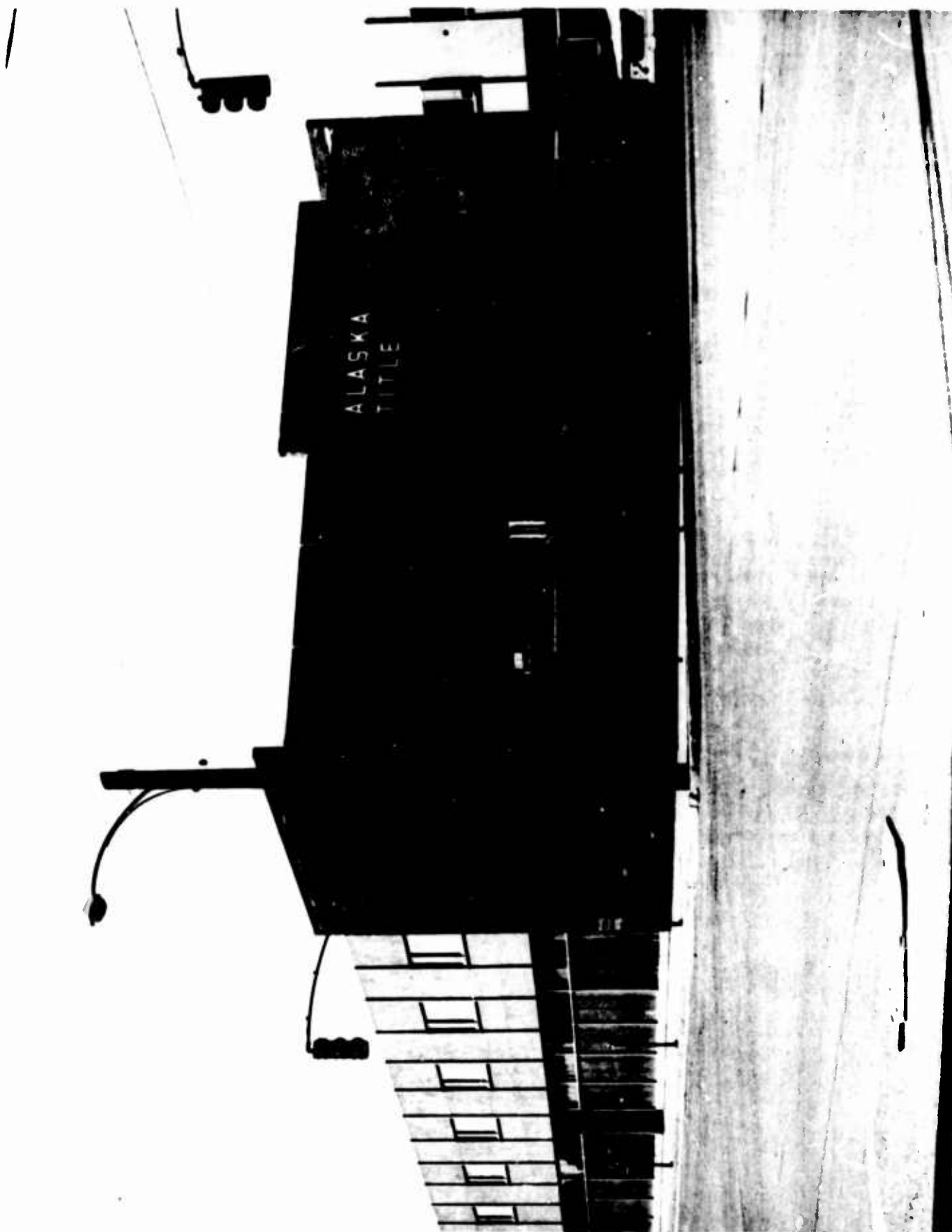


Figure 87. L Street Slide (Commercial building at Sixth Avenue and E Street. No damage apparent.
Note damage to building of same basic design, figure 88.)

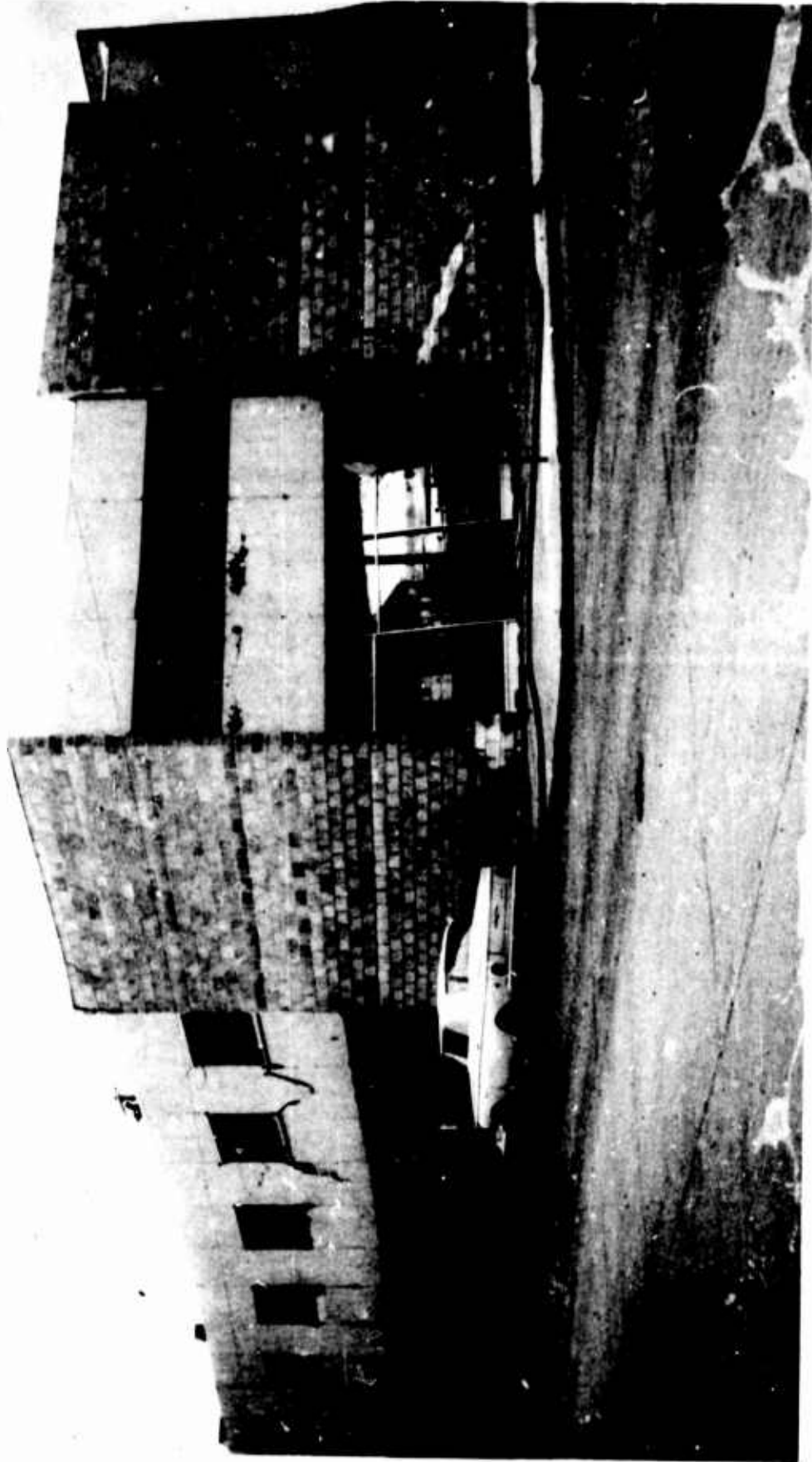


Figure 88. L Street Slide (Commercial building at Fourth Avenue and K Street)

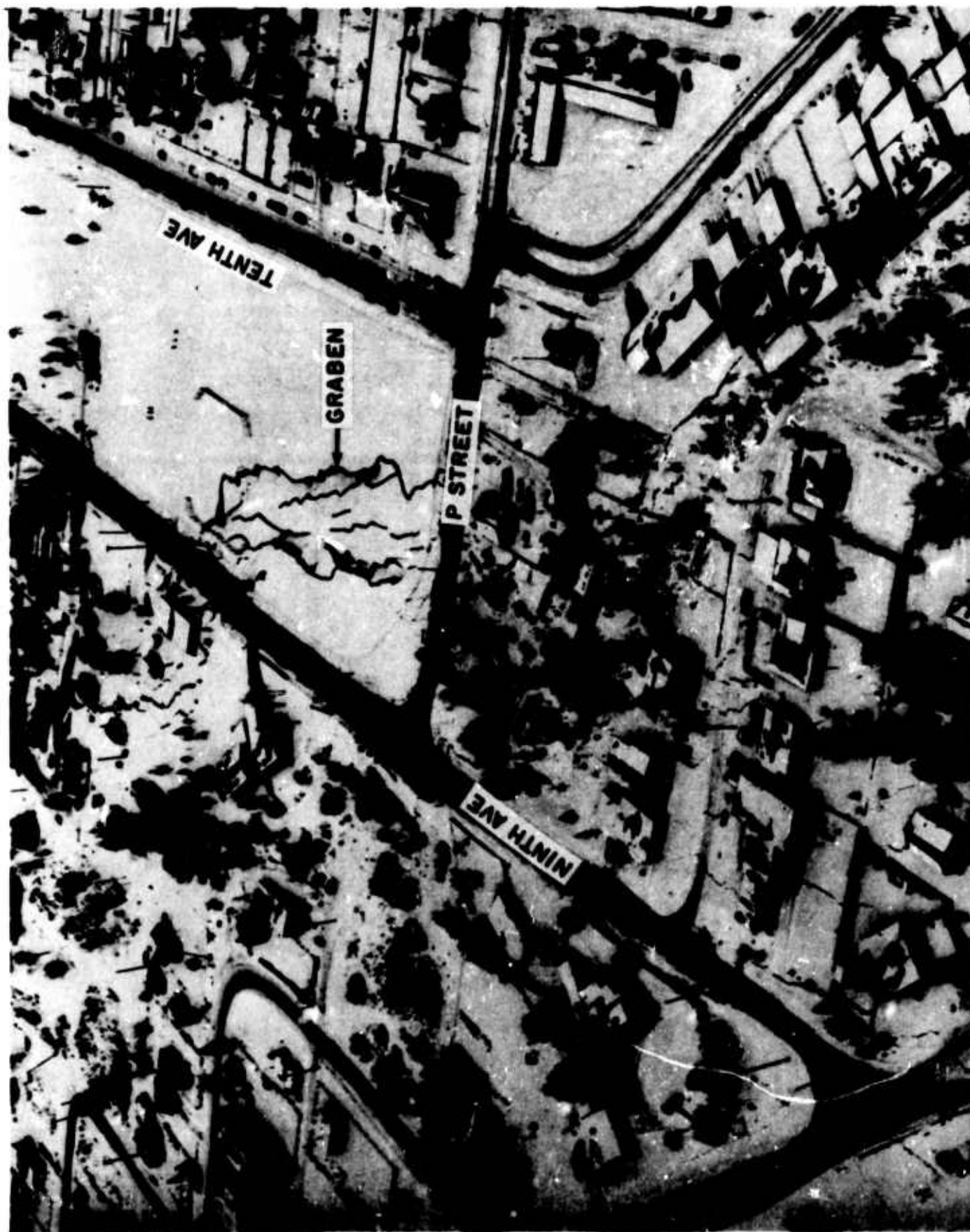


Figure 89. L Street Slide (Western end of graben transversing a city park)



Figure 90. L Street Slide (The graben transversing a city park)



Figure 91. L Street Slide (Knik Arms, a six-story apartment building that moved 11 feet without major damage)

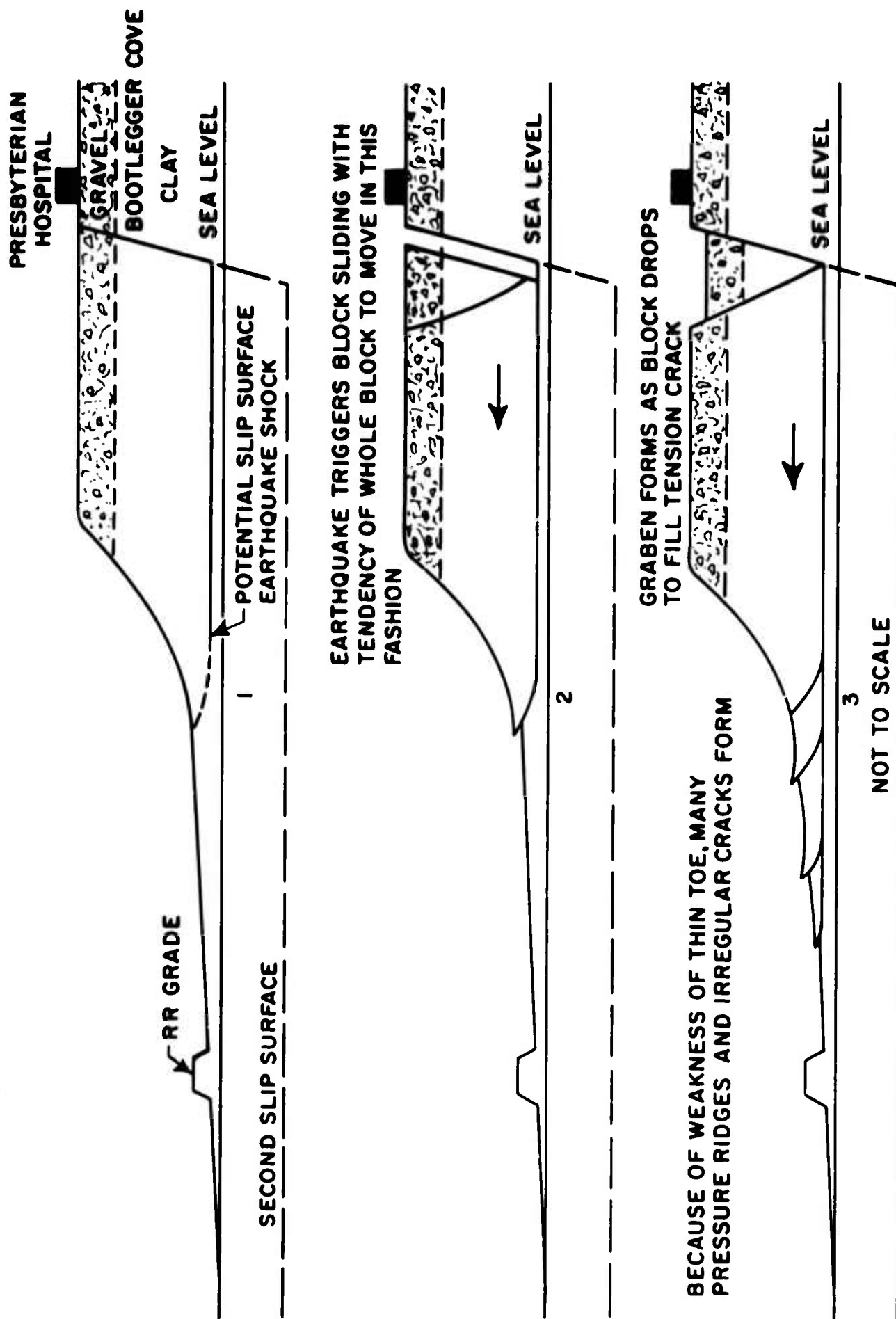


Figure 92. L Street Slide (Idealized cross section of the slide) (Source: References IX-2 and IX-13)

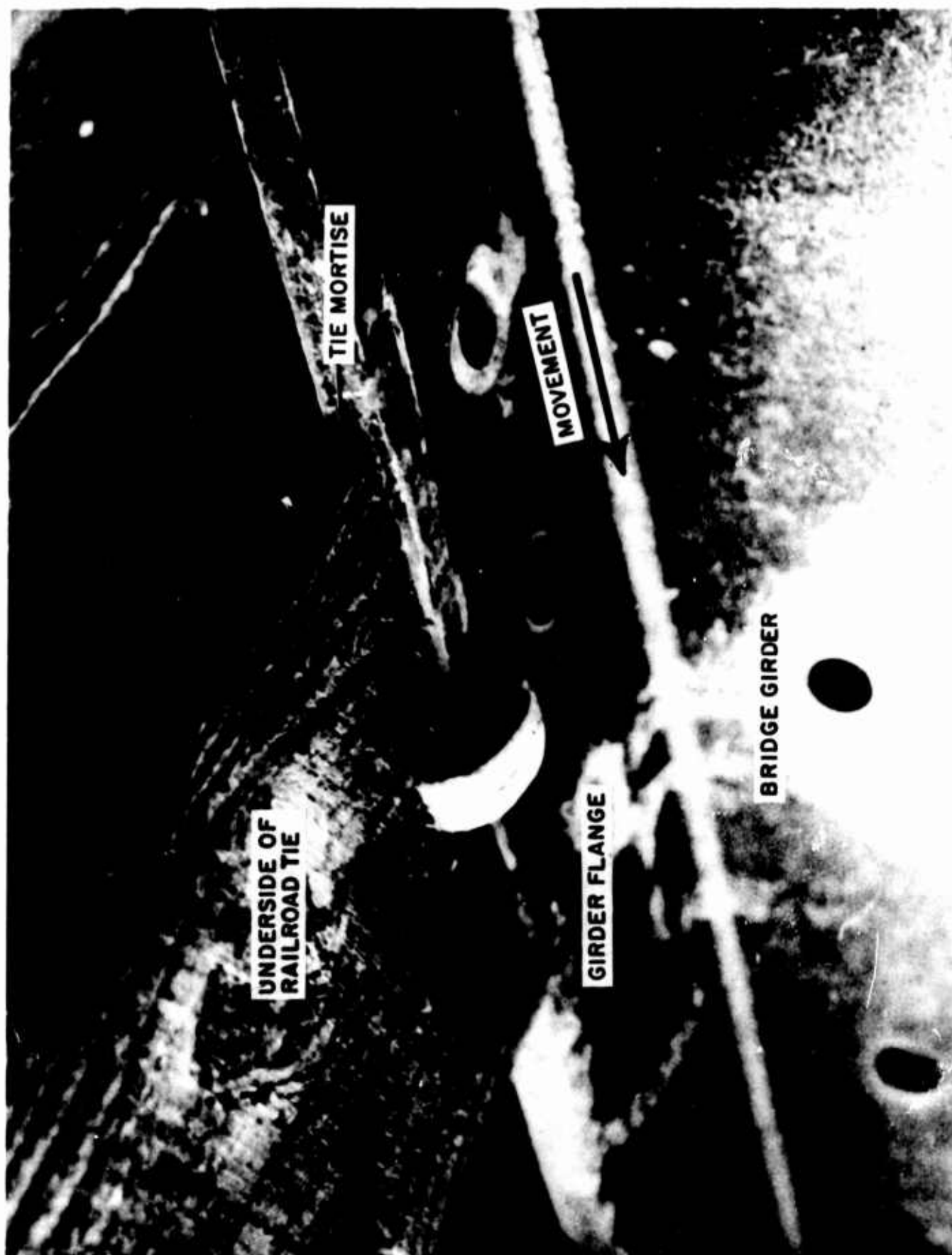


Figure 93. L Street Slide (Track movement at the Ship Creek railroad bridge)



Figure 94. Government Hill Slide (Pre-earthquake aerial view of the slide area)



Figure 95. Government Hill Slide, Mosaic, Vertical Aerial Projection



Figure 96. Government Hill Slide (Aerial view of the slide area)



Figure 97. Government Hill Slide (North-south wing of the Government Hill school)



Figure 98. Government Hill Slide (North-south wing of the Government Hill school)



Figure 99. Government Hill Slide (North-south wing of the Government Hill school)



Figure 100. Government Hill Slide (The Government Hill school looking west)



Figure 101. Government Hill Slide (Looking into the east-west corridor of the Government Hill school)



Figure 102. Government Hill Slide (Northeast corner of the east-west wing of the Government Hill School)



Figure 103. Government Hill Slide (Aerial view of the east end of the slide showing damage to residential buildings)



Figure 104. Government Hill Slide (Destroyed residences)



Figure 105. Government Hill Slide (Residence)



Figure 106. Government Hill Slide (New fill around the west residential building)



Figure 107. Government Hill Slide (View of the west residence from the toe of the slide)

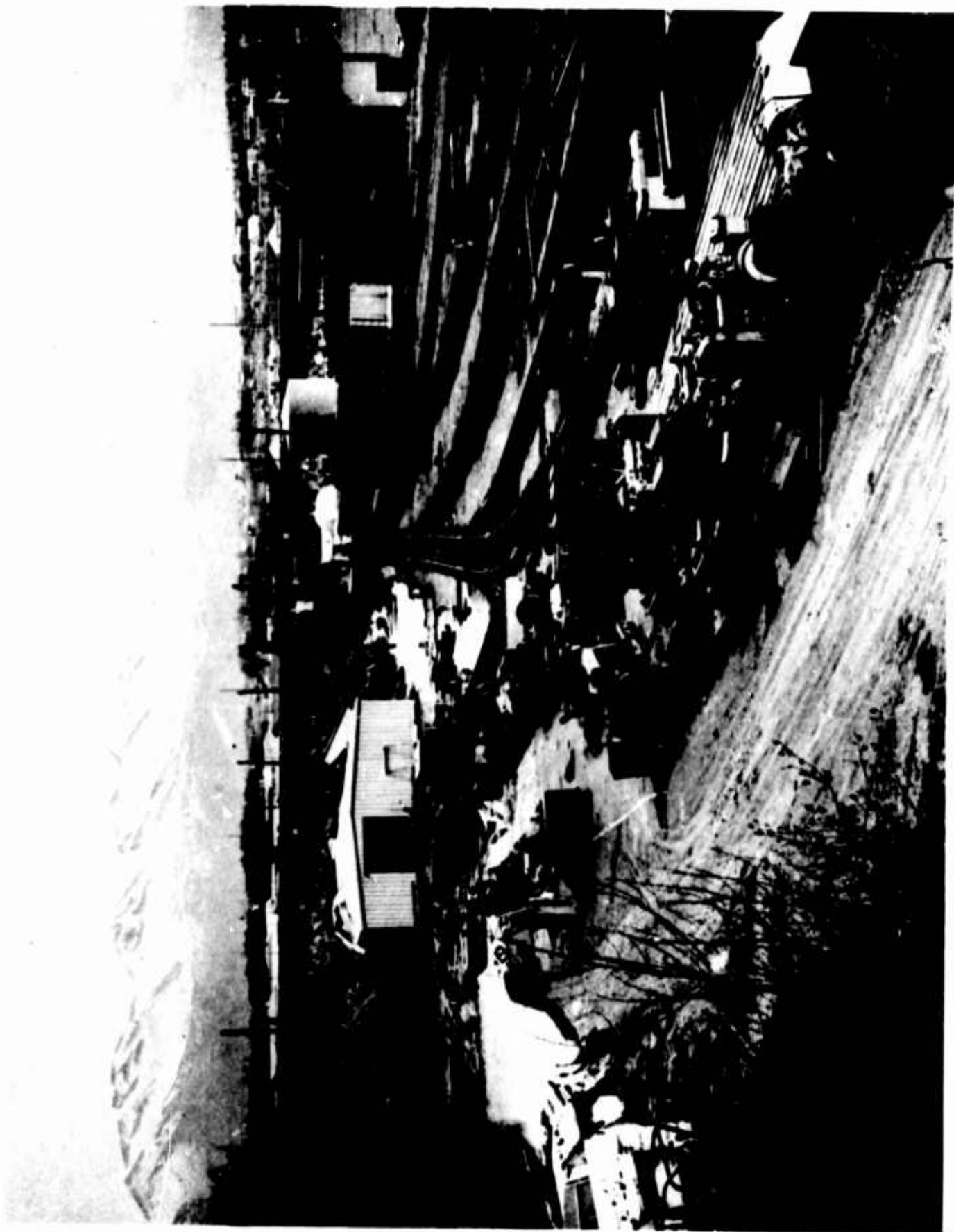


Figure 108. Government Hill Slide (Warehouse used by the Alaska Railroad as it appeared in late May 1964)



Figure 109. Government Hill Slide (Warehouse, foreground, used by the Alaska Railroad as it appeared in late May 1964)



Figure 110. Government Hill Slide (Warehouse used by the Alaska Railroad as it appeared in late May 1964)



Figure 111. Government Hill Slide (Alaska Railroad track equipment damaged by the slide)



Figure 112. Government Hill Slide (Alaska Railroad track covered by a pressure ridge)

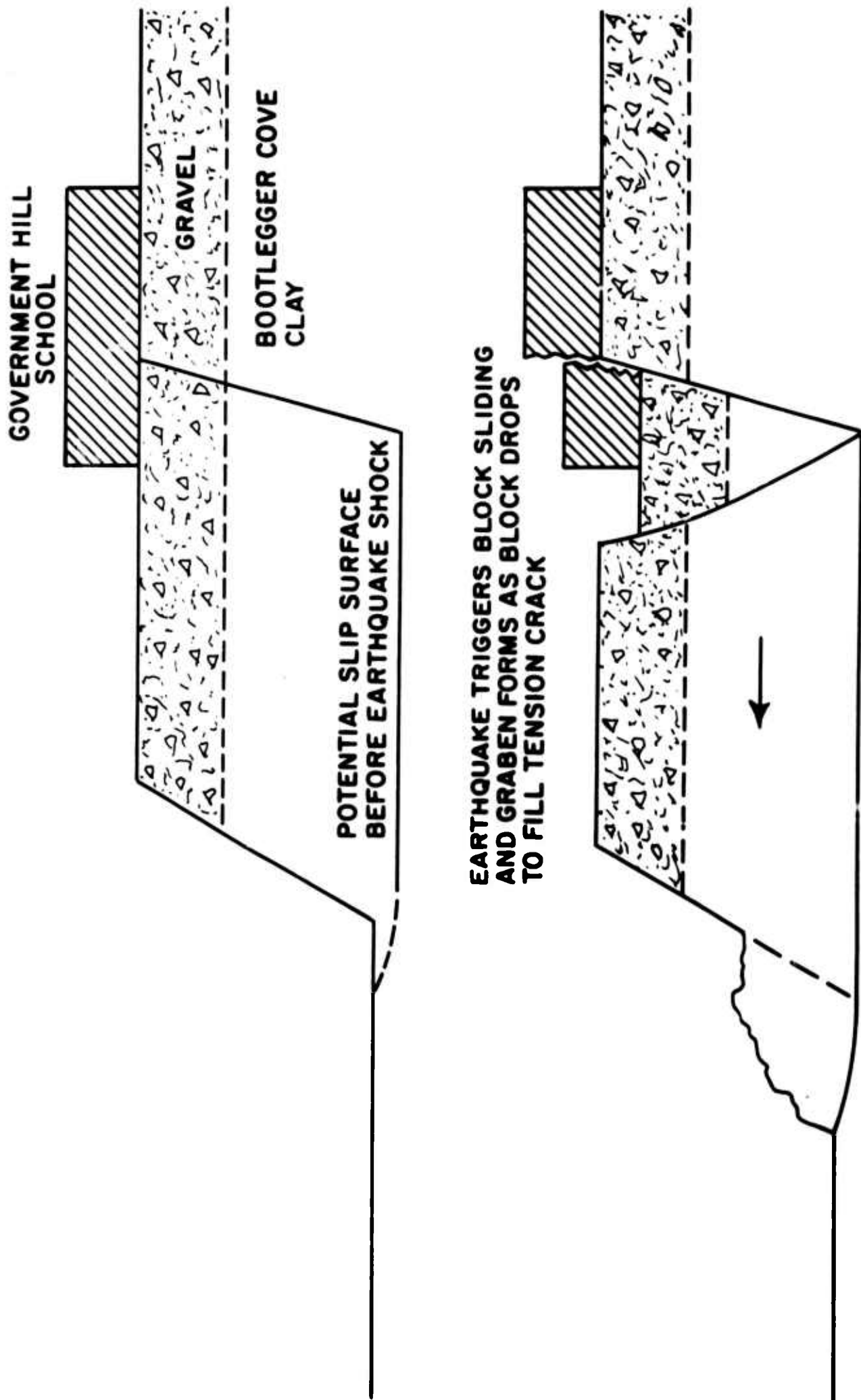


Figure 113. Government Hill Slide (Idealized cross section of the slide) (Source: Reference IX-2)

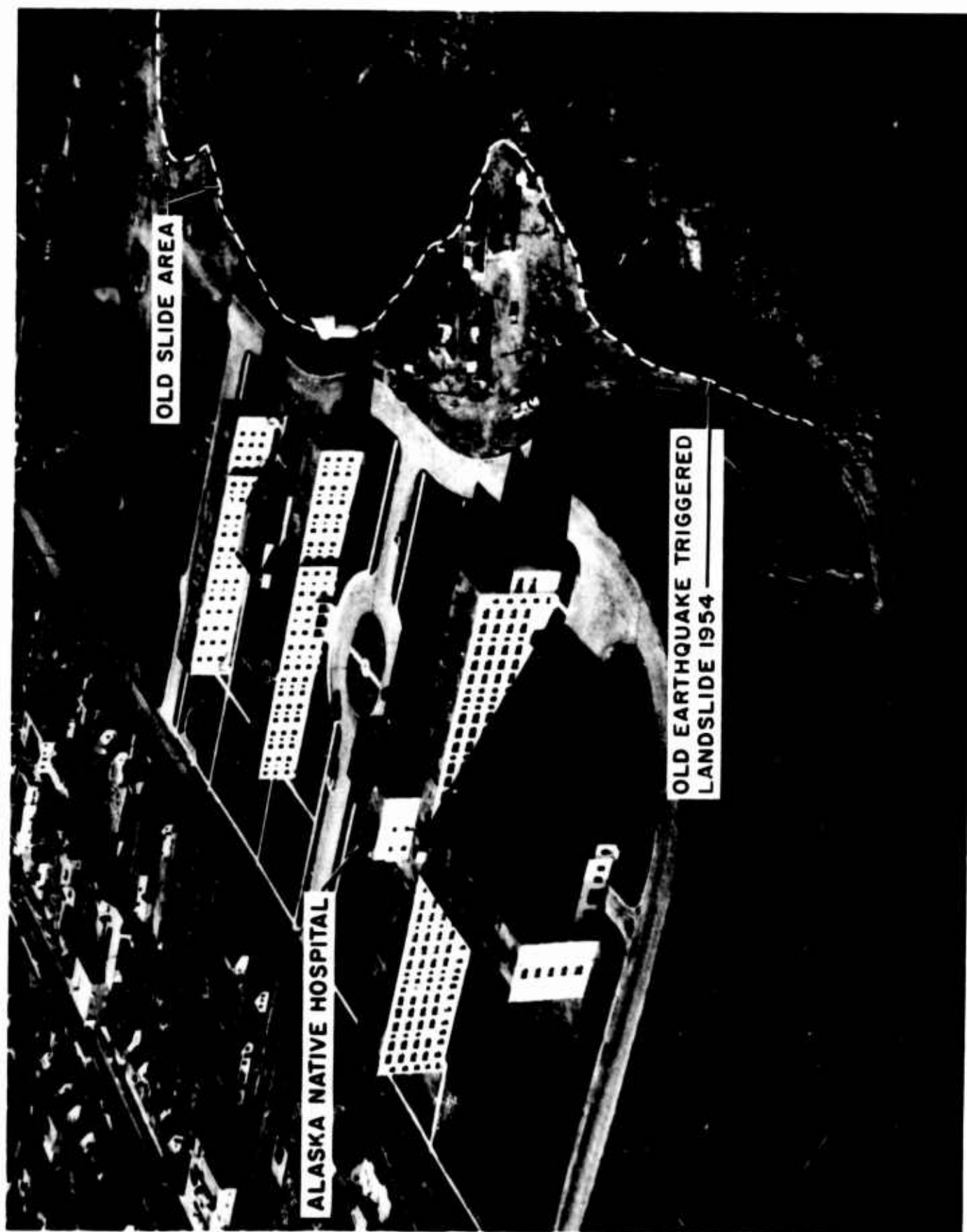


Figure 114. Government Hill Slide (Alaska Native Hospital--old quake slide area indicated by dashed lines)



Figure 115. First Avenue Slide, Mosaic, Vertical Aerial Projection

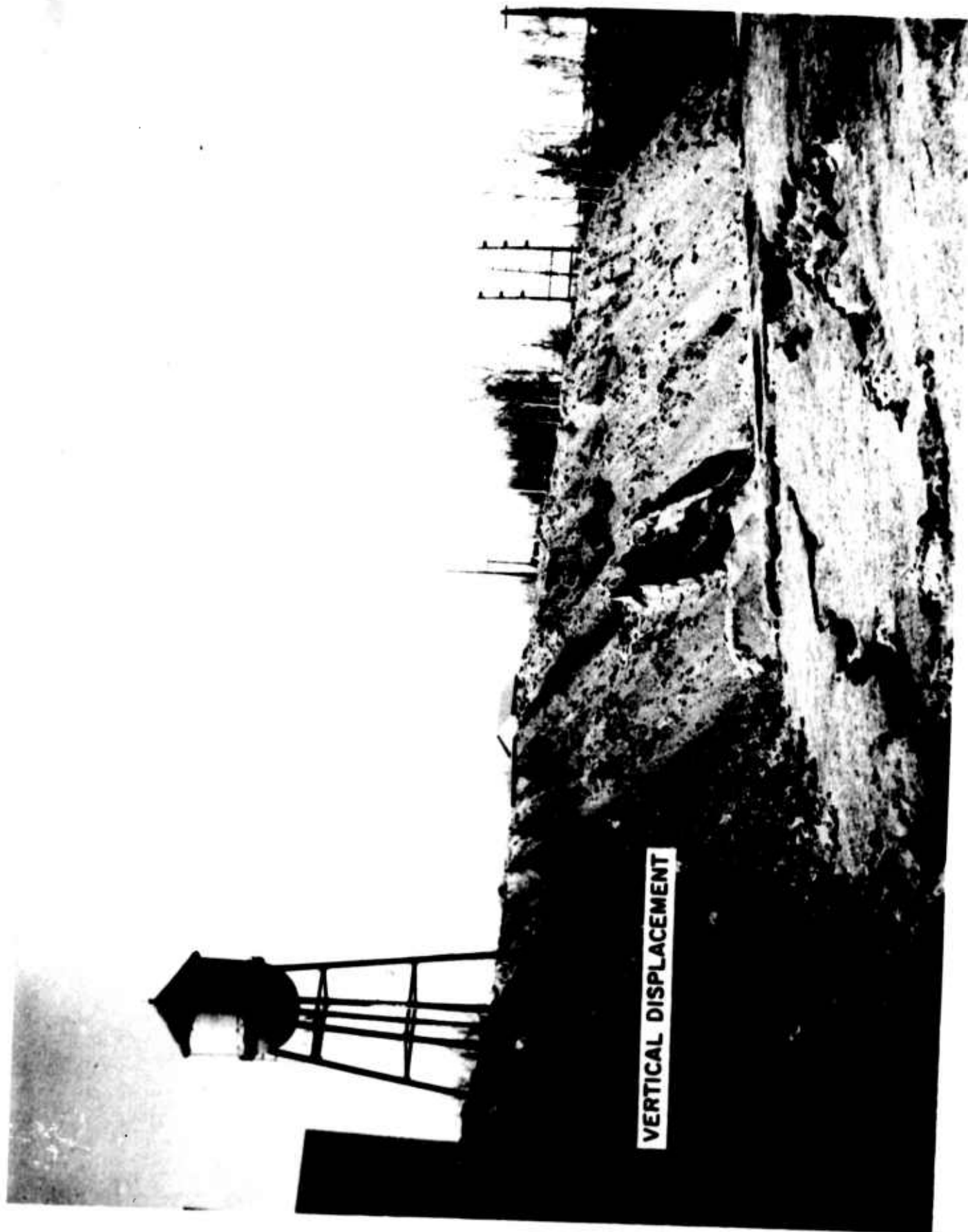


Figure 116. First Avenue Slide (Vertical displacement produced by the graben)



Figure 117. First Avenue Slide (Aerial view of a fuel storage tank destroyed by the slide)

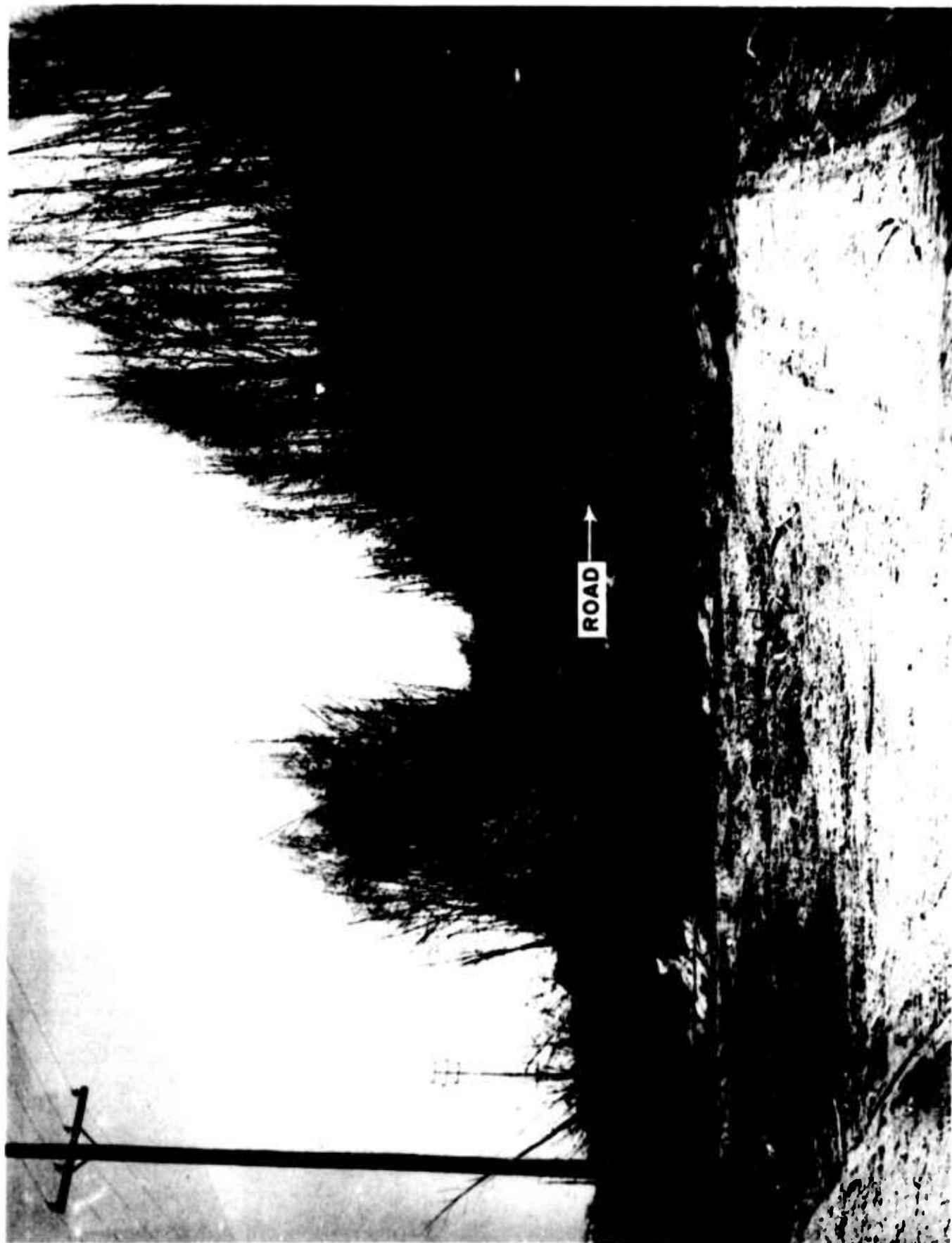


Figure 118. First Avenue Slide (Pressure ridge as it appeared in May 1964)

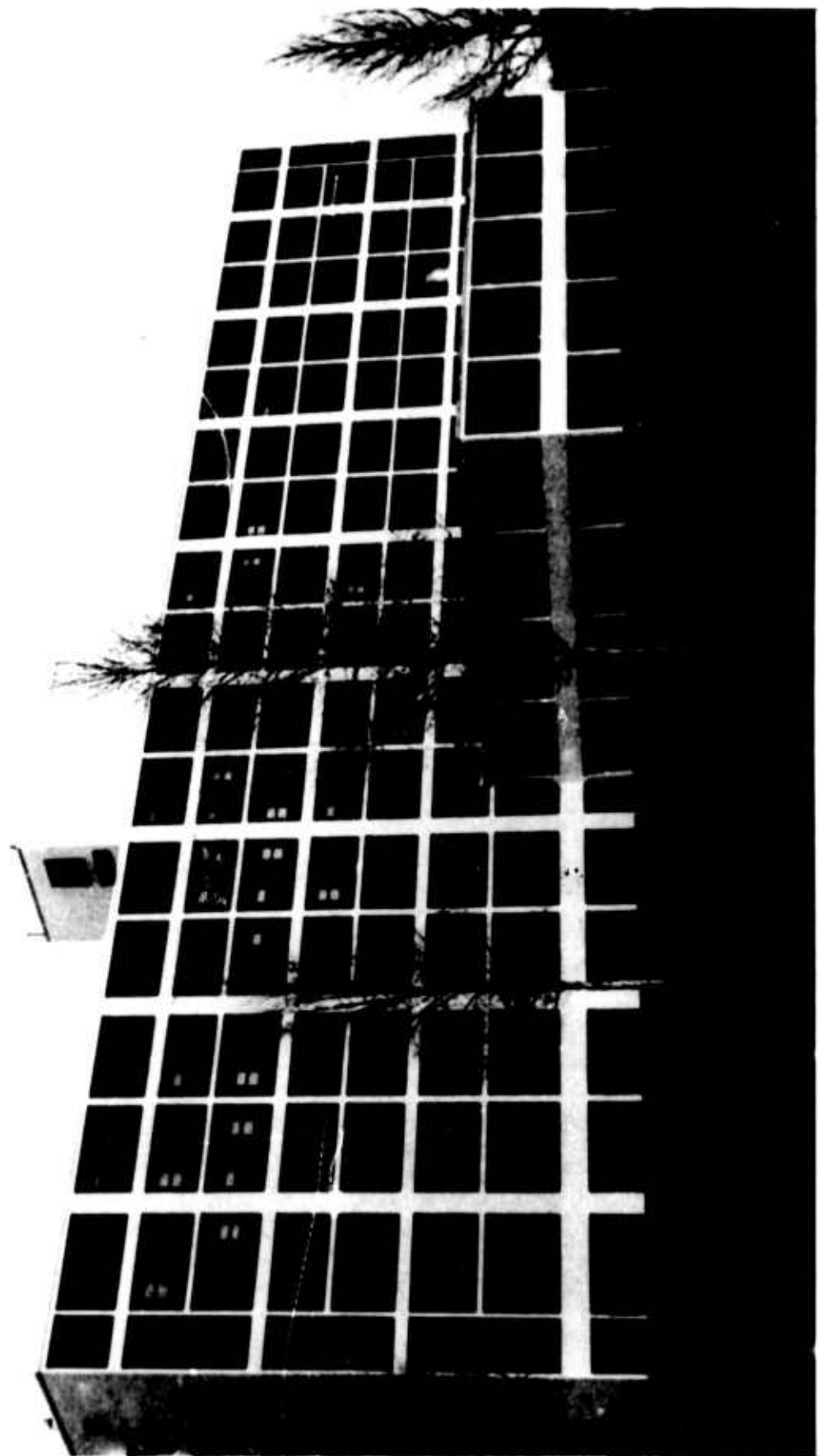


Figure 119. Elmendorf AFB Hospital (South side of the seven-story reinforced-concrete frame)



Figure 120. Elmendorf AFB Hospital (Diagonal tension cracks in masonry-filler walls)

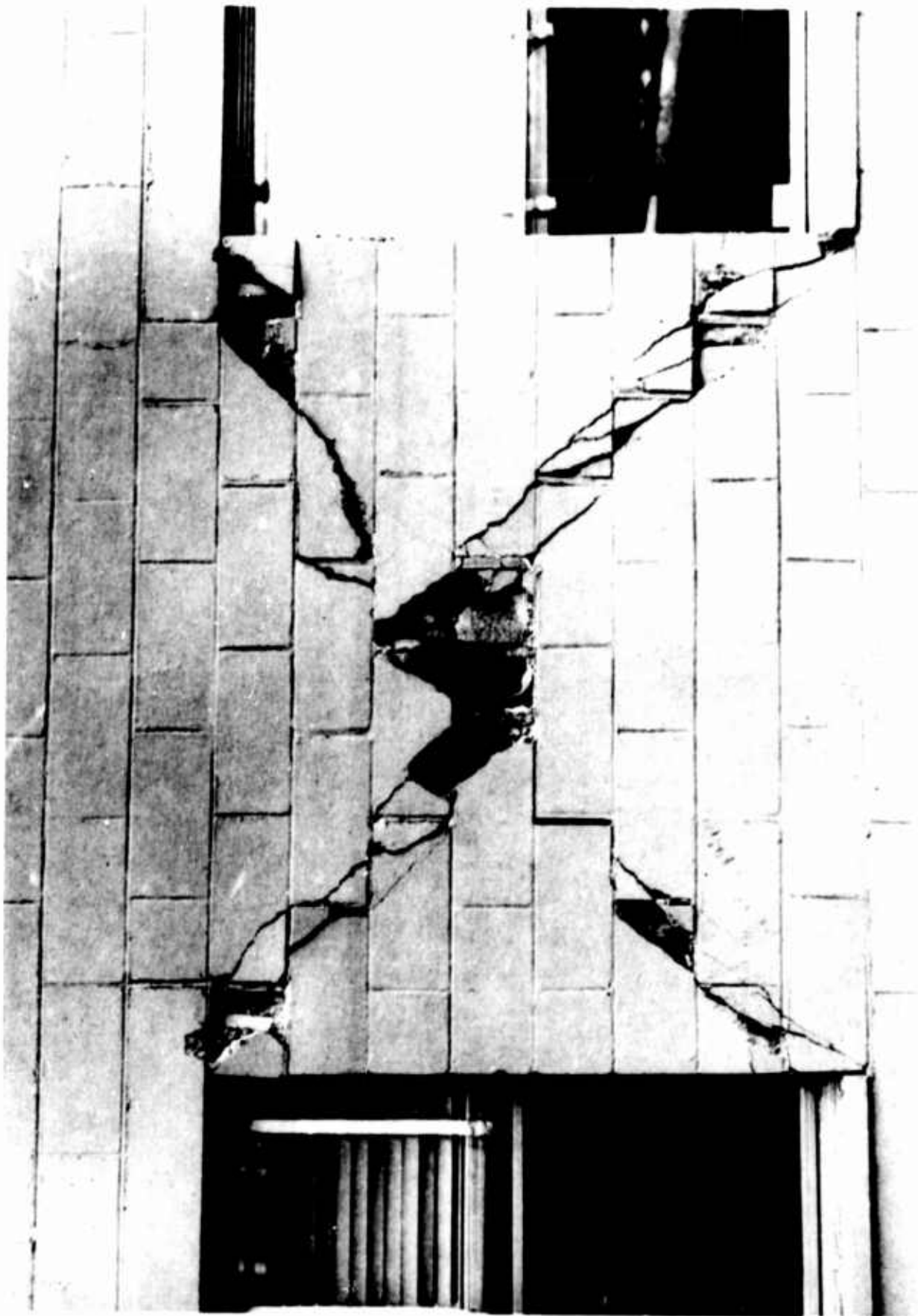


Figure 121. Elmendorf AFB Hospital (Closeup of diagonal tension cracks in masonry-filler wall)

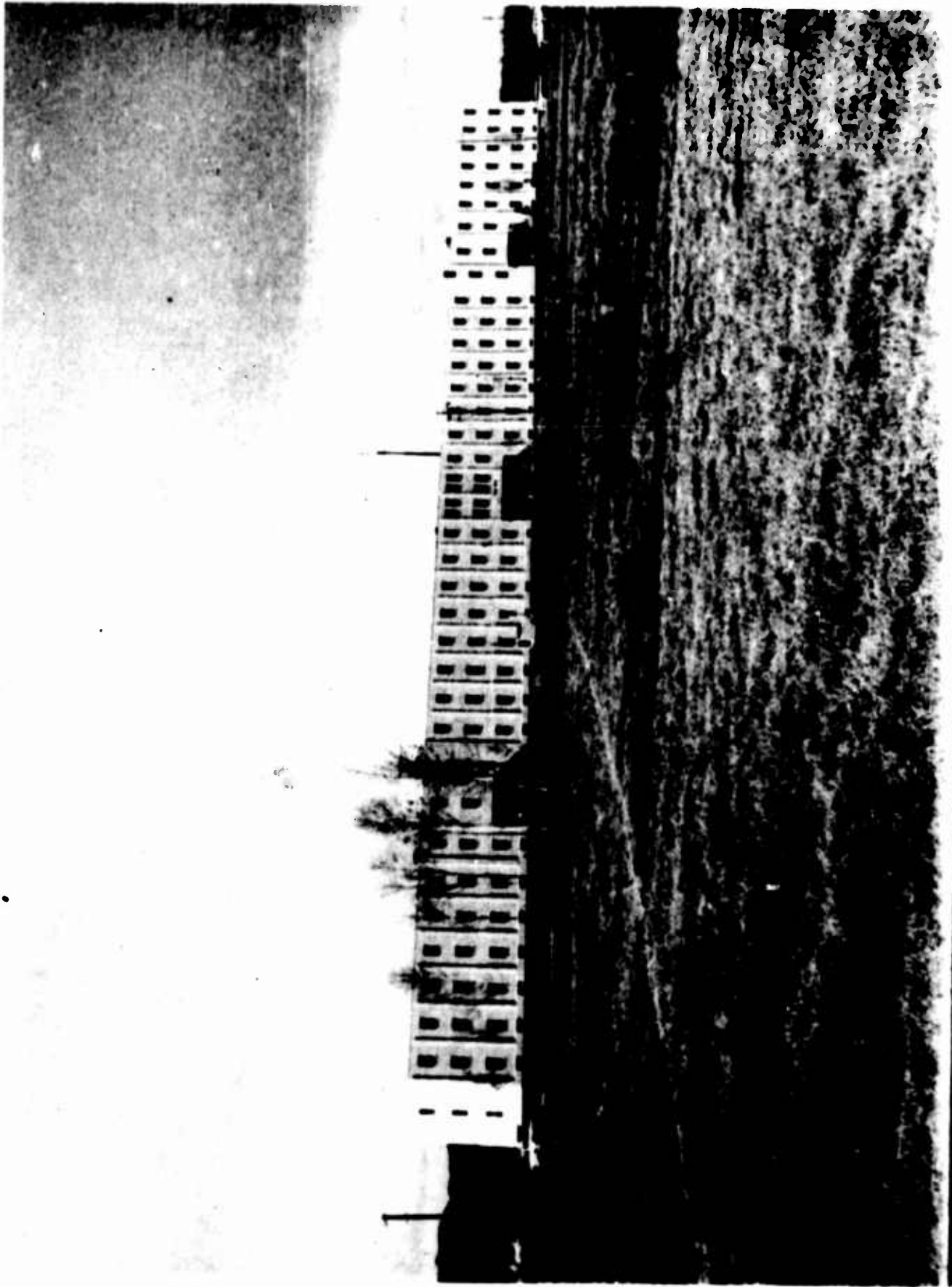


Figure 122. Elmendorf AFB 750-Man Barracks (South side of Building 31-270.
Notice that the columns project beyond walls)



Figure 123. Elmendorf AFB 750-Man Barracks (East end of Building 31-270 showing expansion joints)

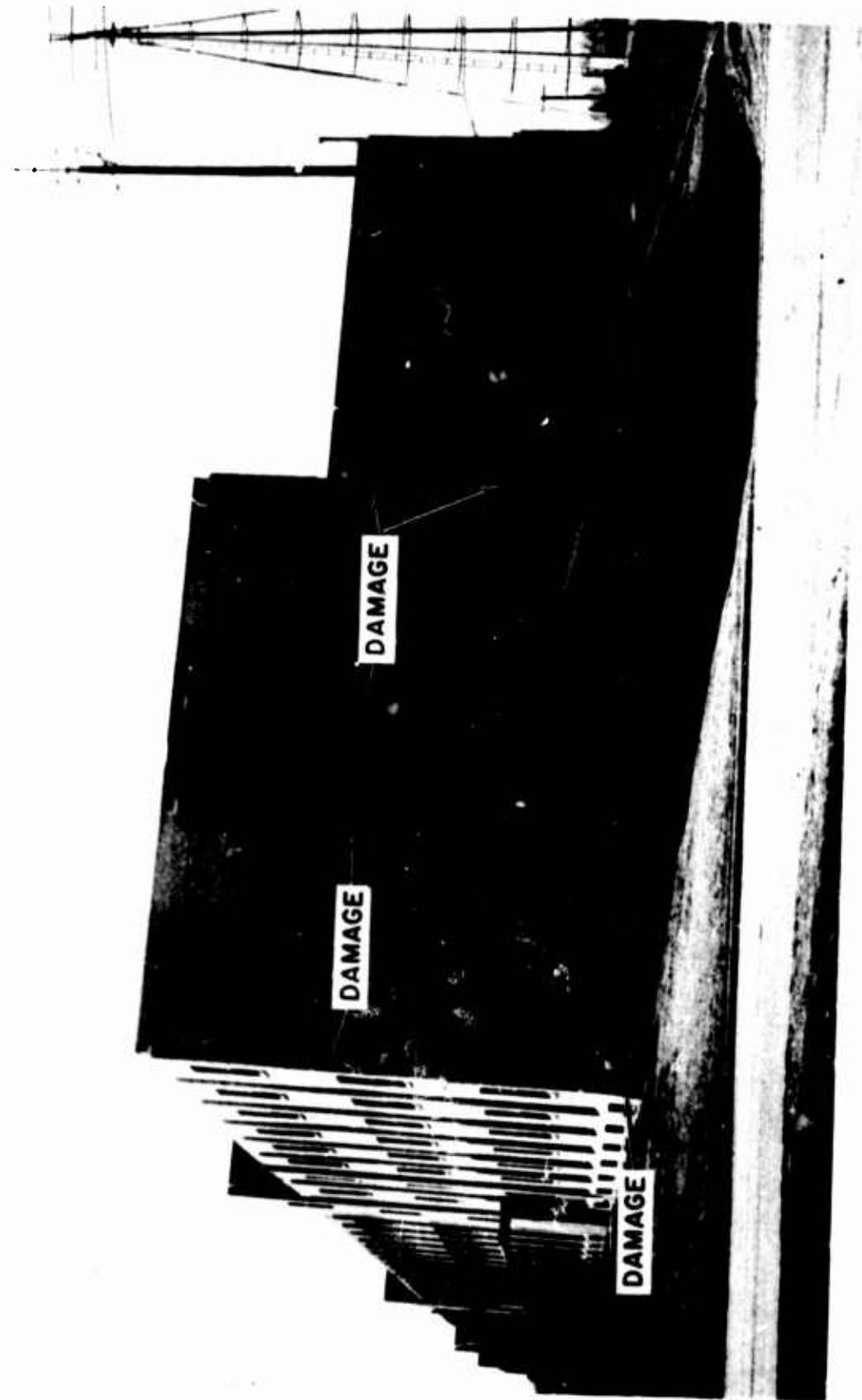


Figure 124. Elmendorf AFB 750-Man Barracks (East side of Building 31-270 showing projecting wing and cracks in structural frame)

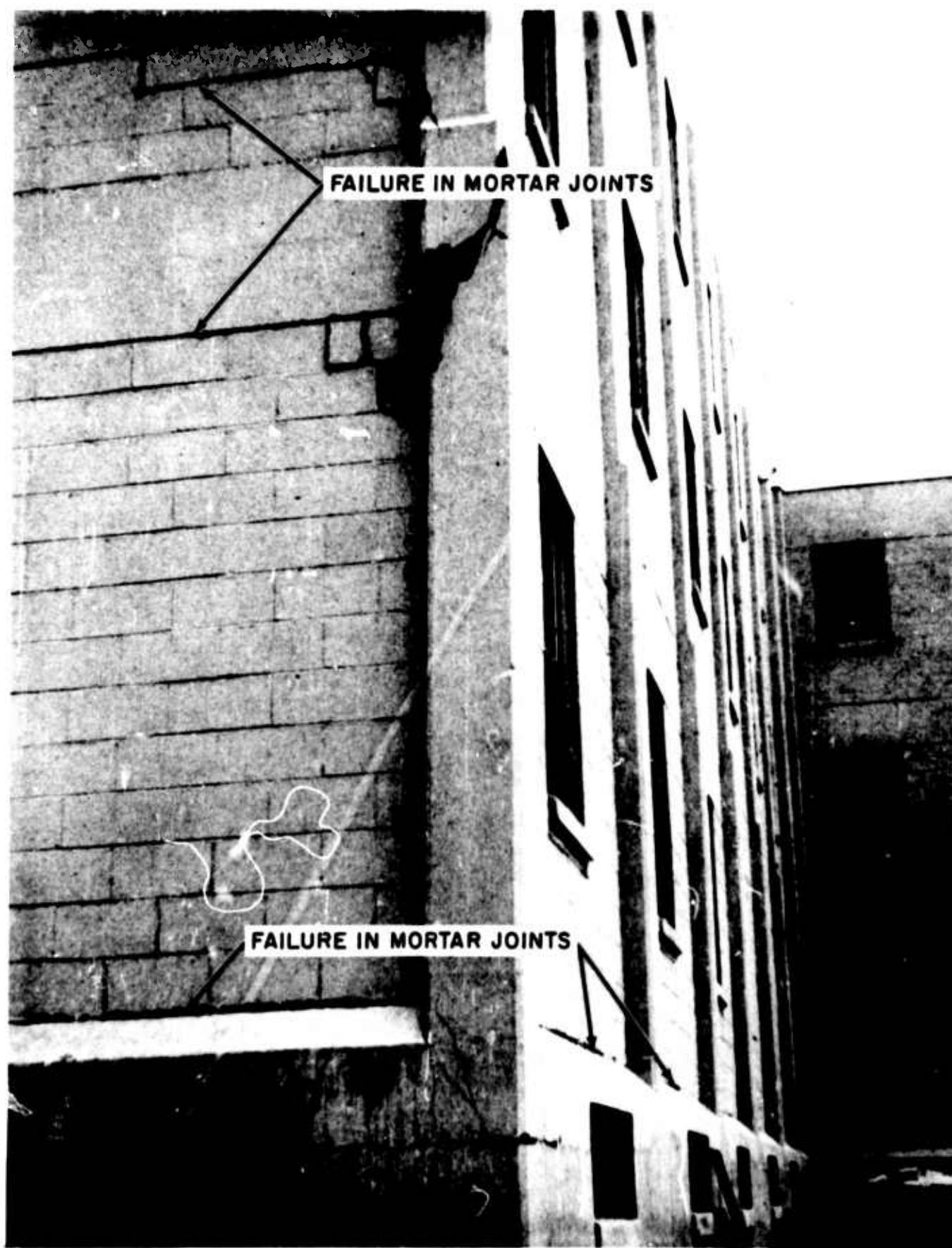


Figure 125. Elmendorf AFB 750-Man Barracks (Closeup of column shear failure at second-floor level in northeast corner of Building 31-250)



Figure 126. Elmendorf AFB 750-Man Barracks (Column shear failure at first-floor level in northeast corner of Building 31-250. Notice absence of ties in failure zone.)

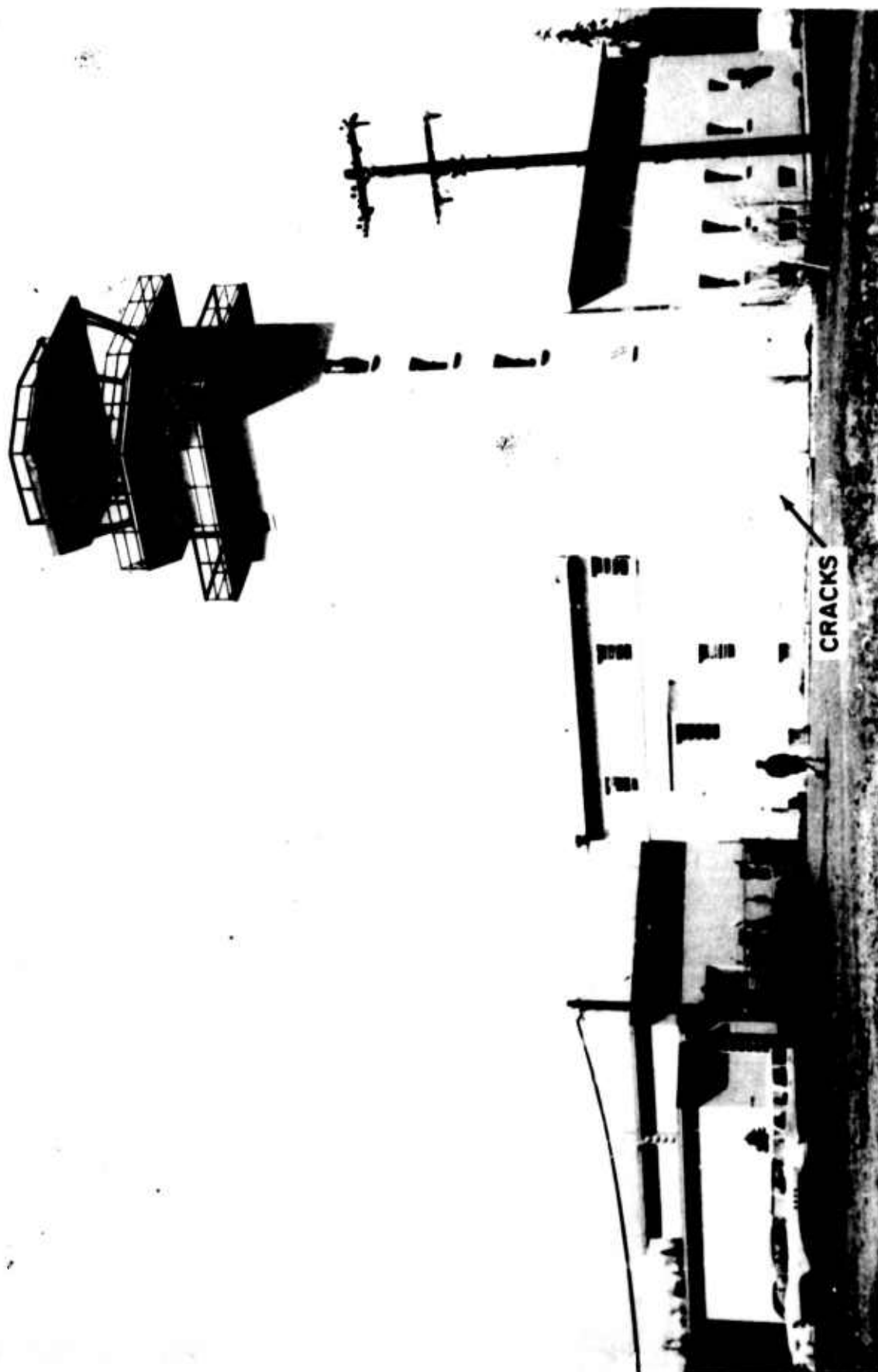


Figure 127. Elmendorf AFB Aircraft Control Tower (Southeast corner of tower)

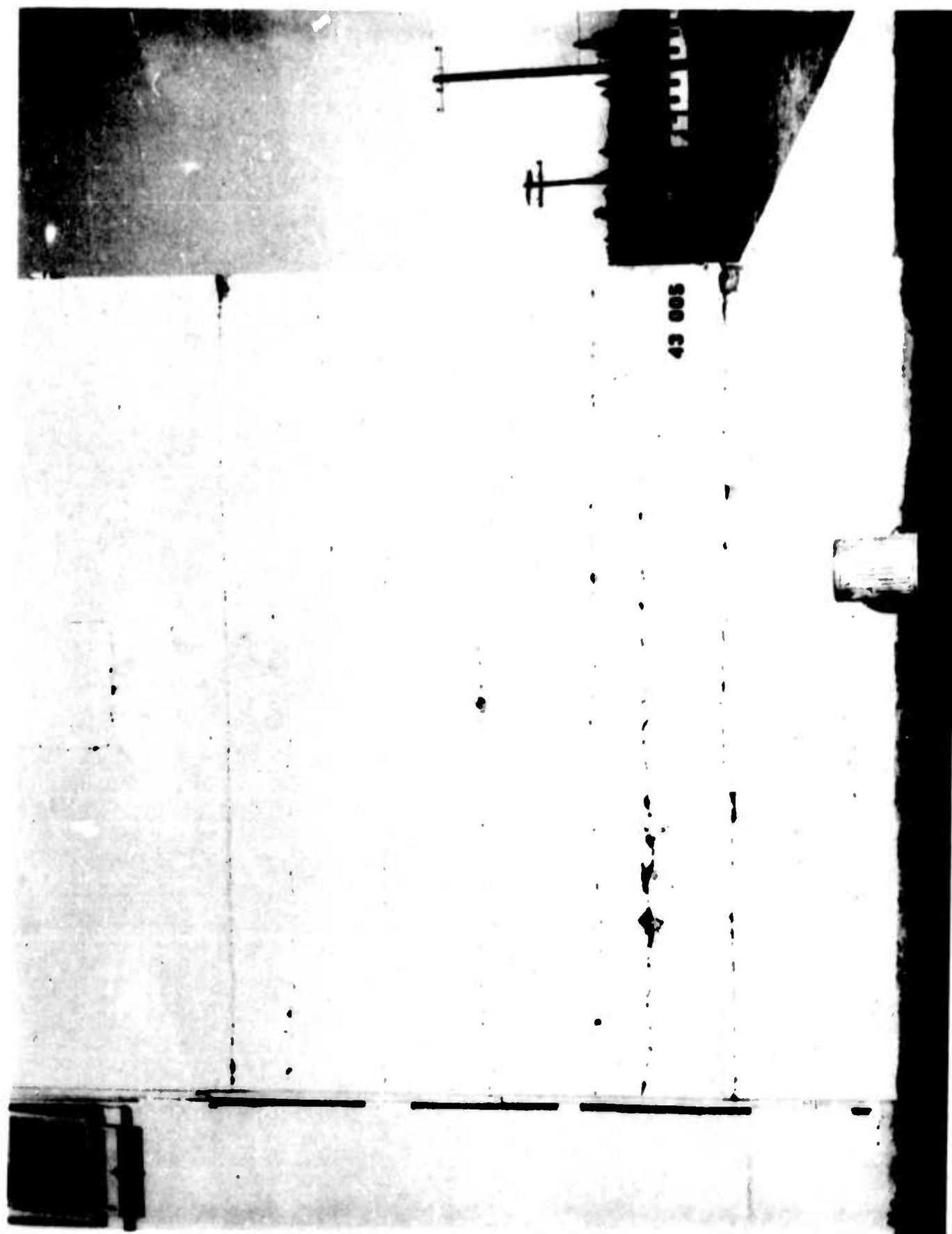


Figure 128. Elmendorf AFB Aircraft Control Tower (Horizontal flexural crack pattern at base of tower)

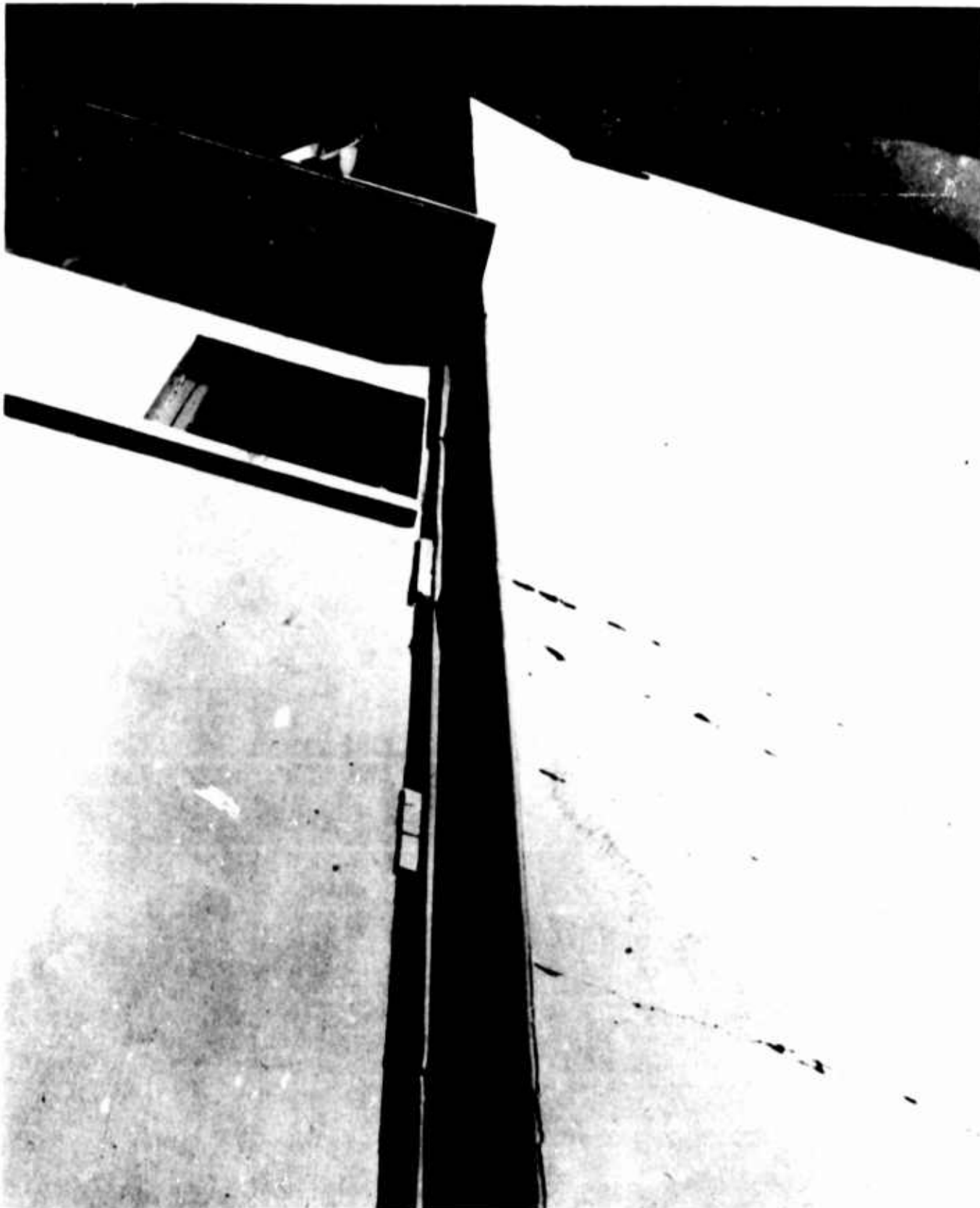


Figure 129. Elmendorf AFB Aircraft Control Tower (Horizontal crack pattern stopped about level with roof of adjoining Communications Building)



Figure 130. Elmendorf AFB Aircraft Control Tower (Closeup of horizontal crack following a construction joint at southeast corner of tower. Note spalling of paint and concrete.)

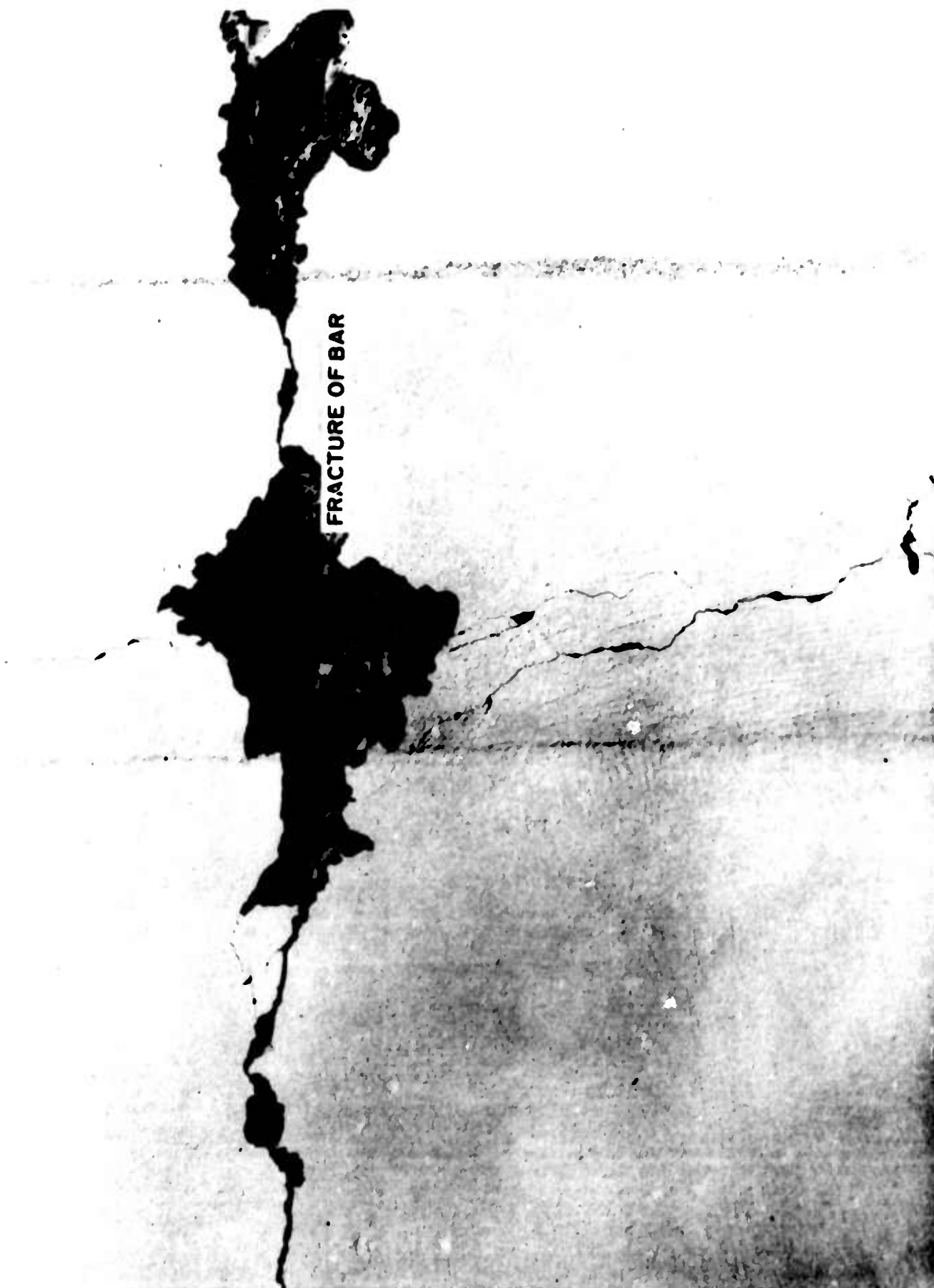


Figure 131. Elmendorf AFB Aircraft Control Tower (Closeup of horizontal crack following reinforcing in south wall. Notice buckled and fractured vertical bar.)

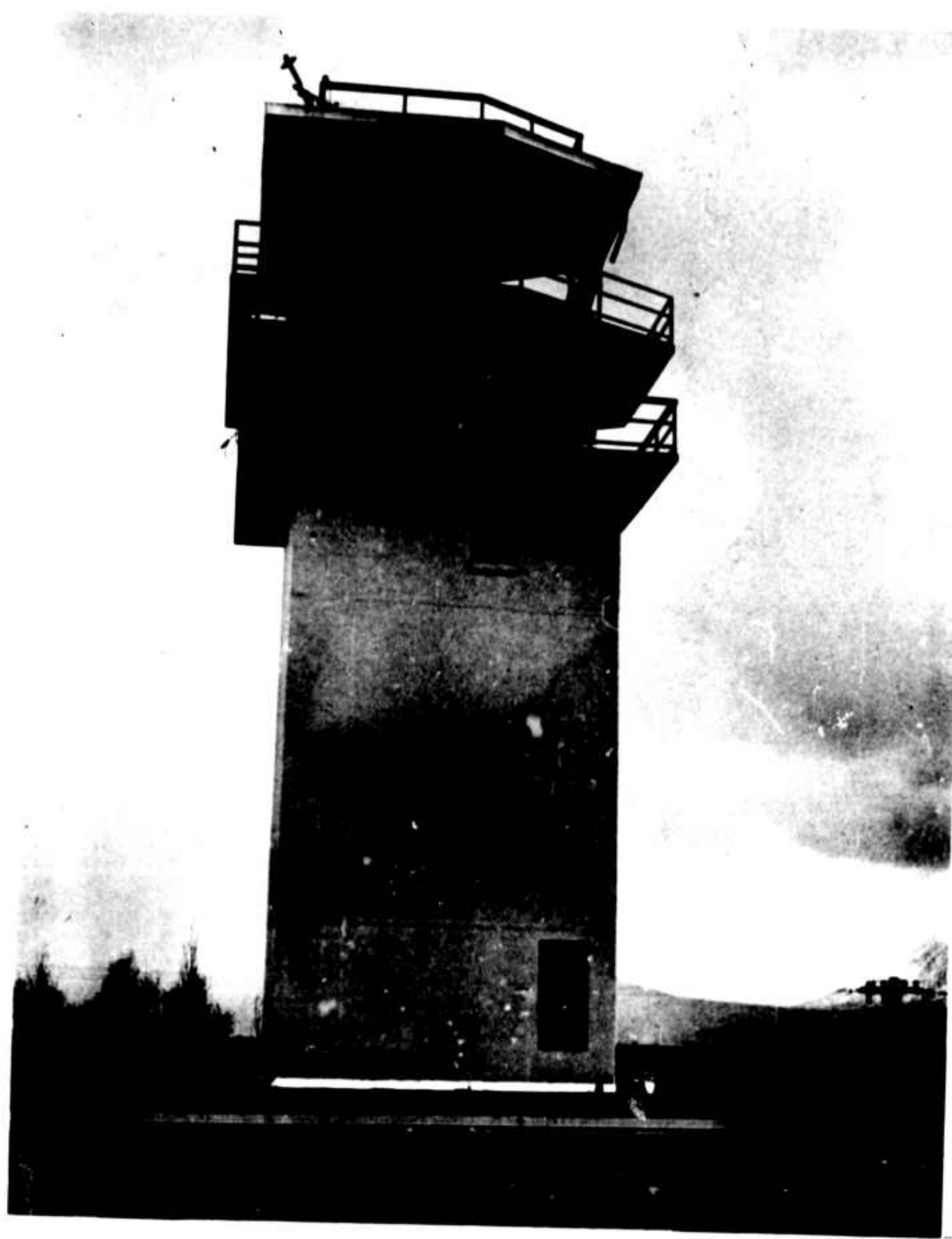


Figure 132. Elmendorf AFB Aircraft Control Tower
(West wall of tower above level of Communications Building roof)



Figure 133. Elmendorf AFB Aircraft Control Tower
(Severely damaged observation cupola)



Figure 134. Anchorage international Airport Control Tower
(Before the earthquake)



Figure 135. Anchorage International Airport Control Tower (After the earthquake)

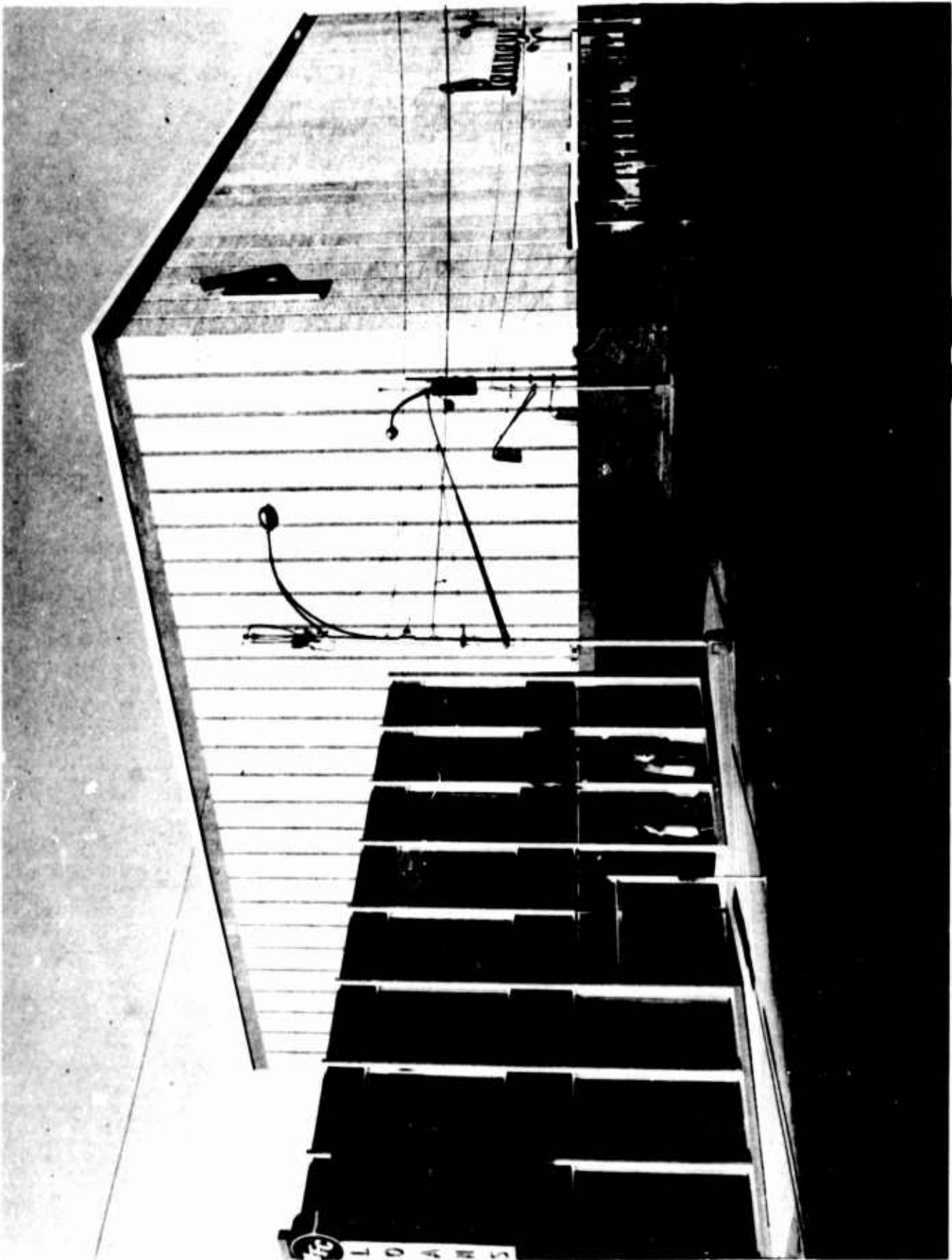




Figure 137. J. C. Penney Building (Fallen precast reinforced-concrete curtain wall panels along the north side of the structure)



Figure 138. J. C. Penney Building (Unseated shear panels in the east wall. Notice the scalloped bottoms of the shear panels.)



Figure 139. J. C. Penney Building
(Collapsed northeast corner of the structure)



Figure 140. J. C. Penney Building (Damage to the northwest corner of the structure. Notice numerous floor slab failures.)

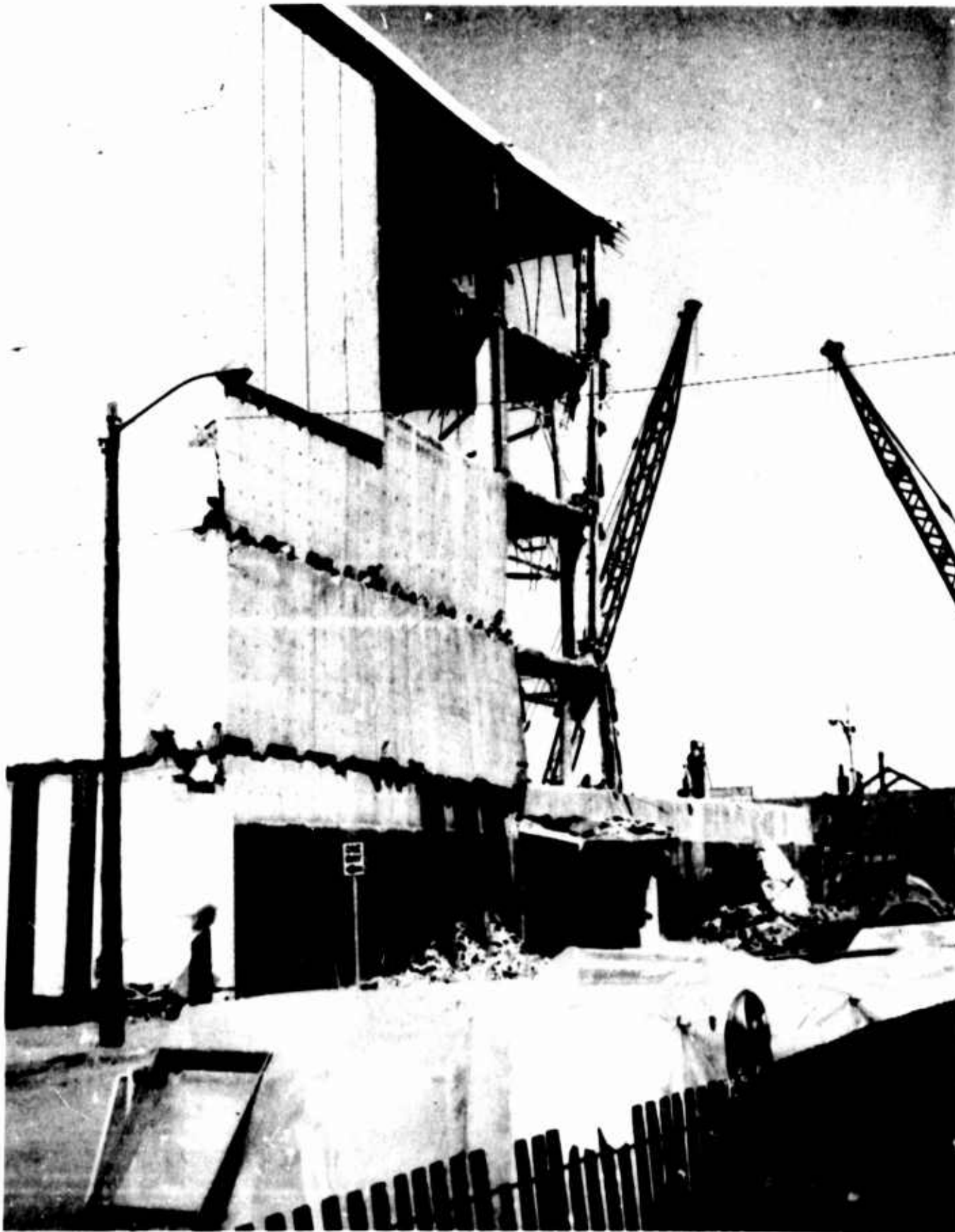


Figure 141. J. C. Penney Building (East side of the structure during demolition showing unseated shear panels, floor slab failures, and intact first-story walls)



Figure 142. J. C. Penney Building (West side of the structure during demolition showing unseated shear panels and fractured column. Adjacent building has been razed to make room for demolition operations.)

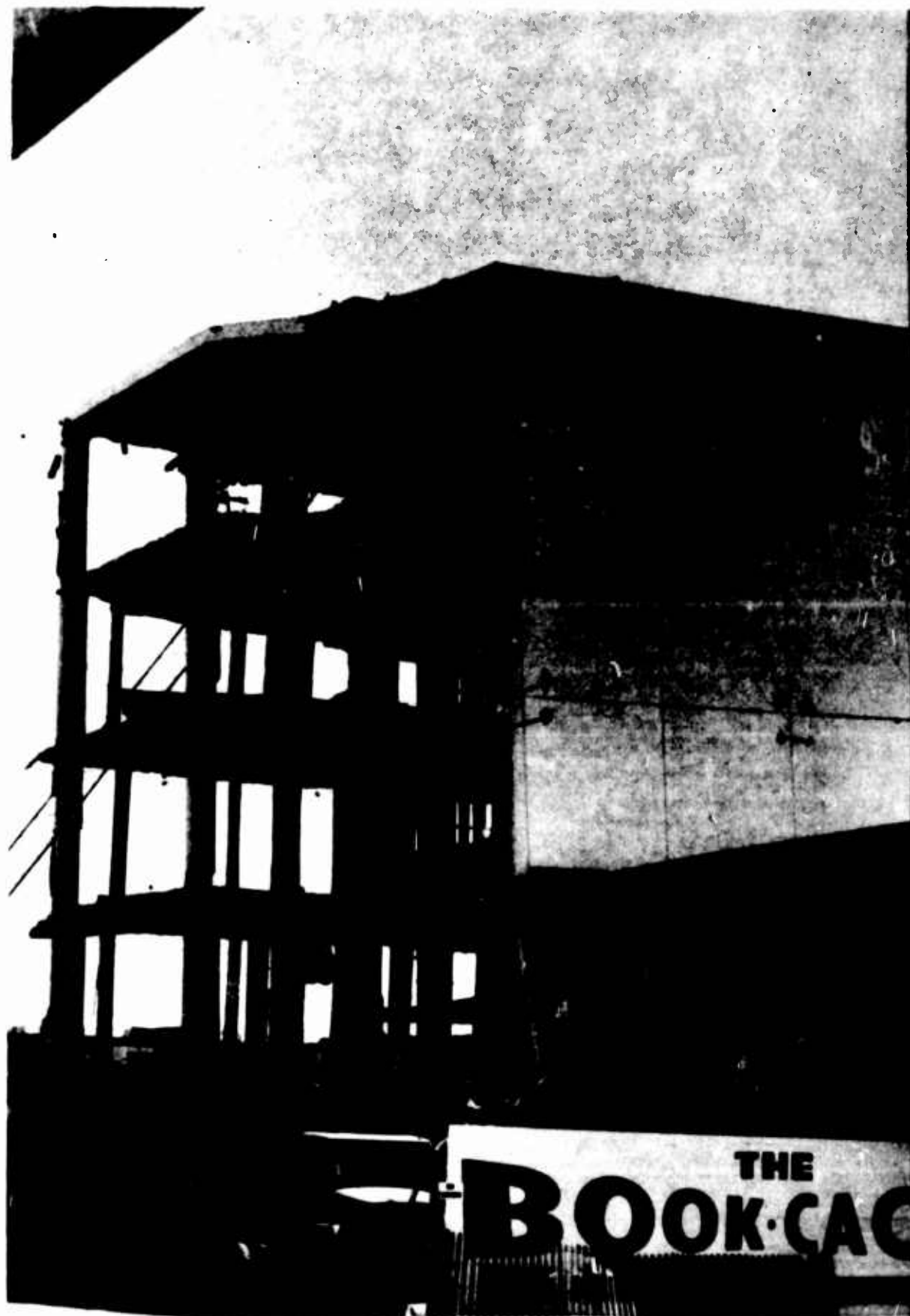


Figure 143. J. C. Penney Building (Floor slab failures along the north side of the structure)



Figure 144. Mount McKinley Building (East side of the fourteen-story reinforced-concrete structure showing diagonal tension cracks in spandrel walls)

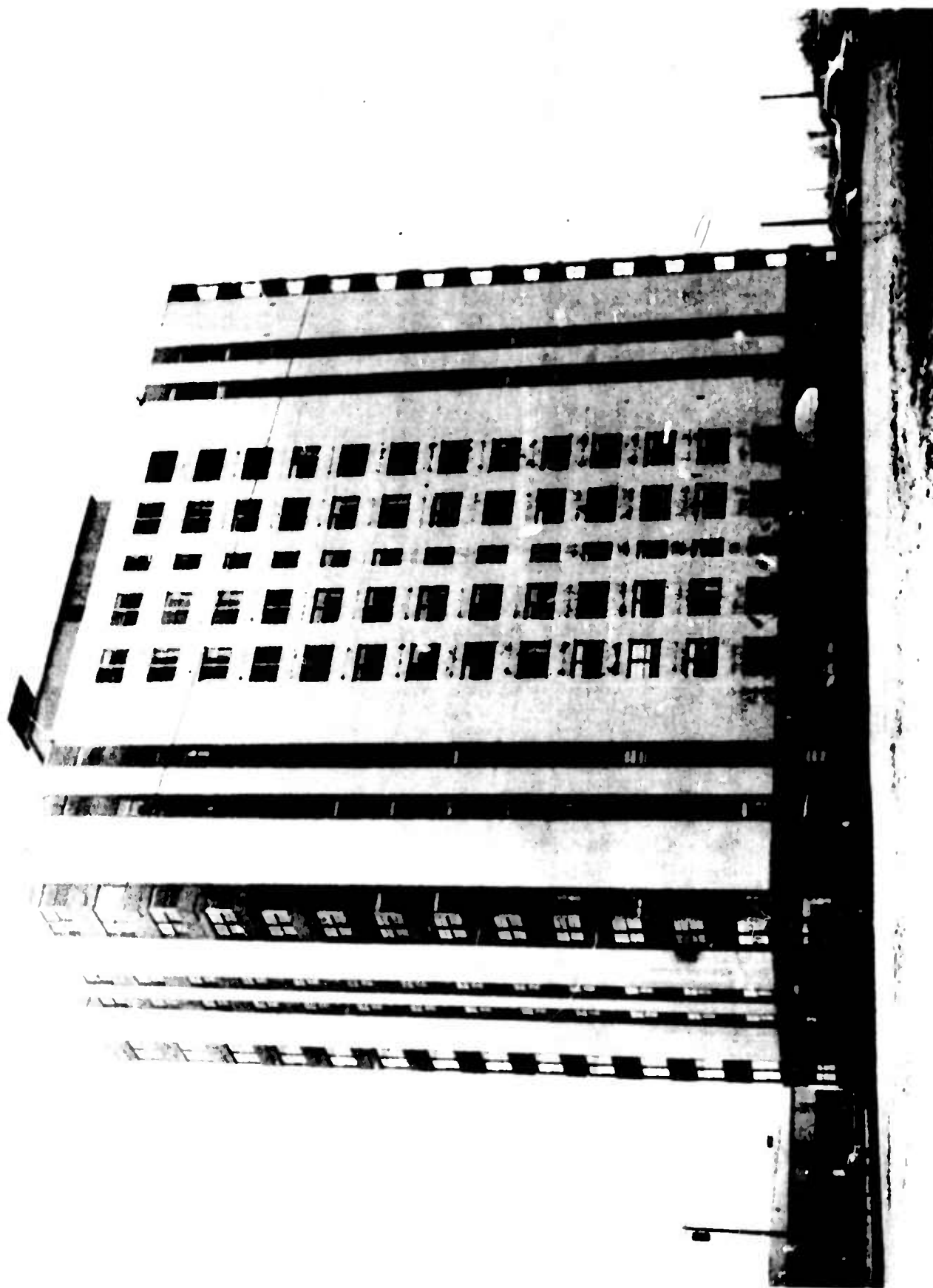


Figure 145. Twelve-Hundred L Street Apartments (West side of the structure.
Structural twin to the Mount McKinley Building.)

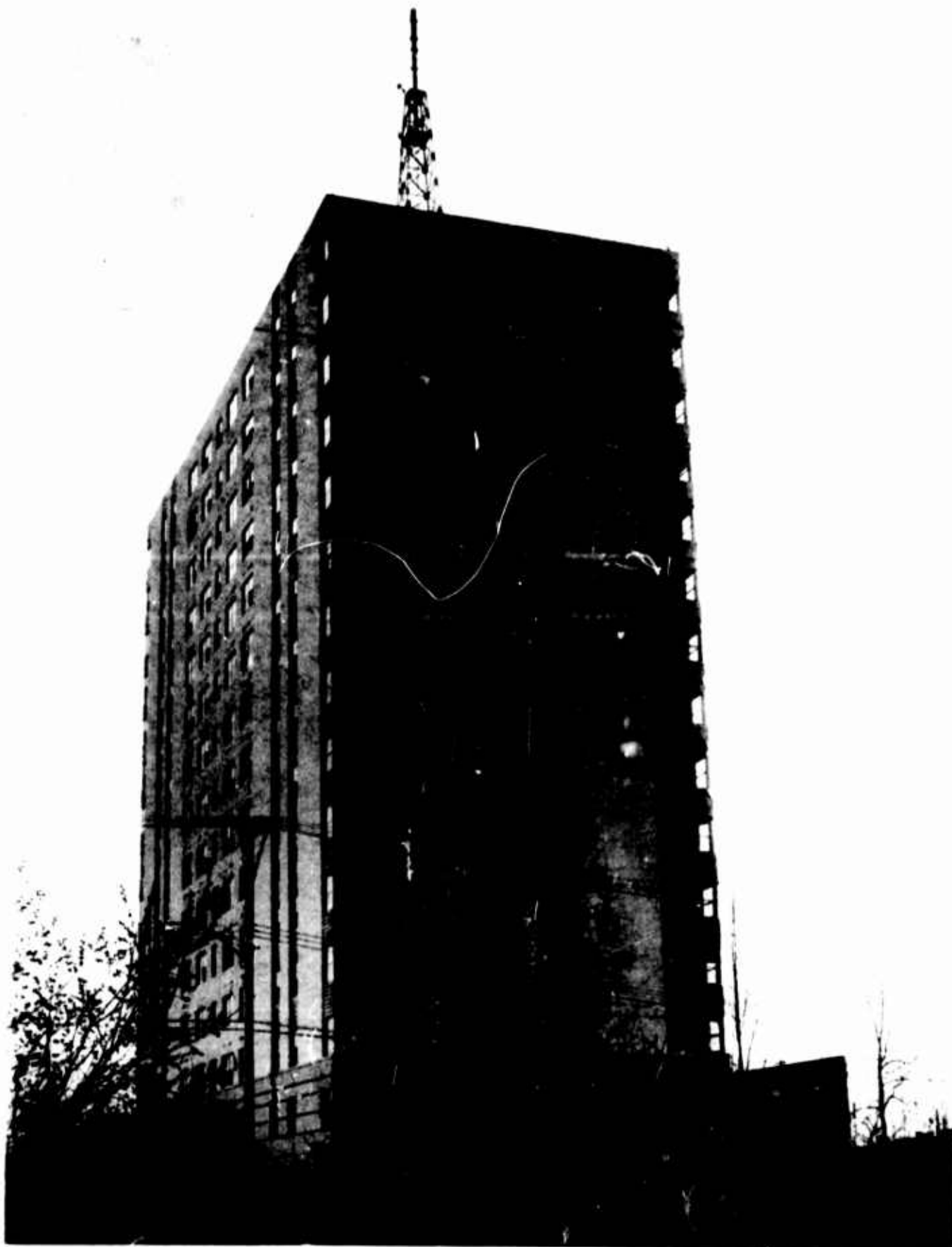


Figure 146. Mount McKinley Building (North side of the structure showing column wall fracture just below the fourth-floor level. TV-radio mast undamaged.)



Figure 147. Twelve-Hundred L Street Apartments
(South side of the structure showing column wall fracture midway between the
second- and third-floor levels)

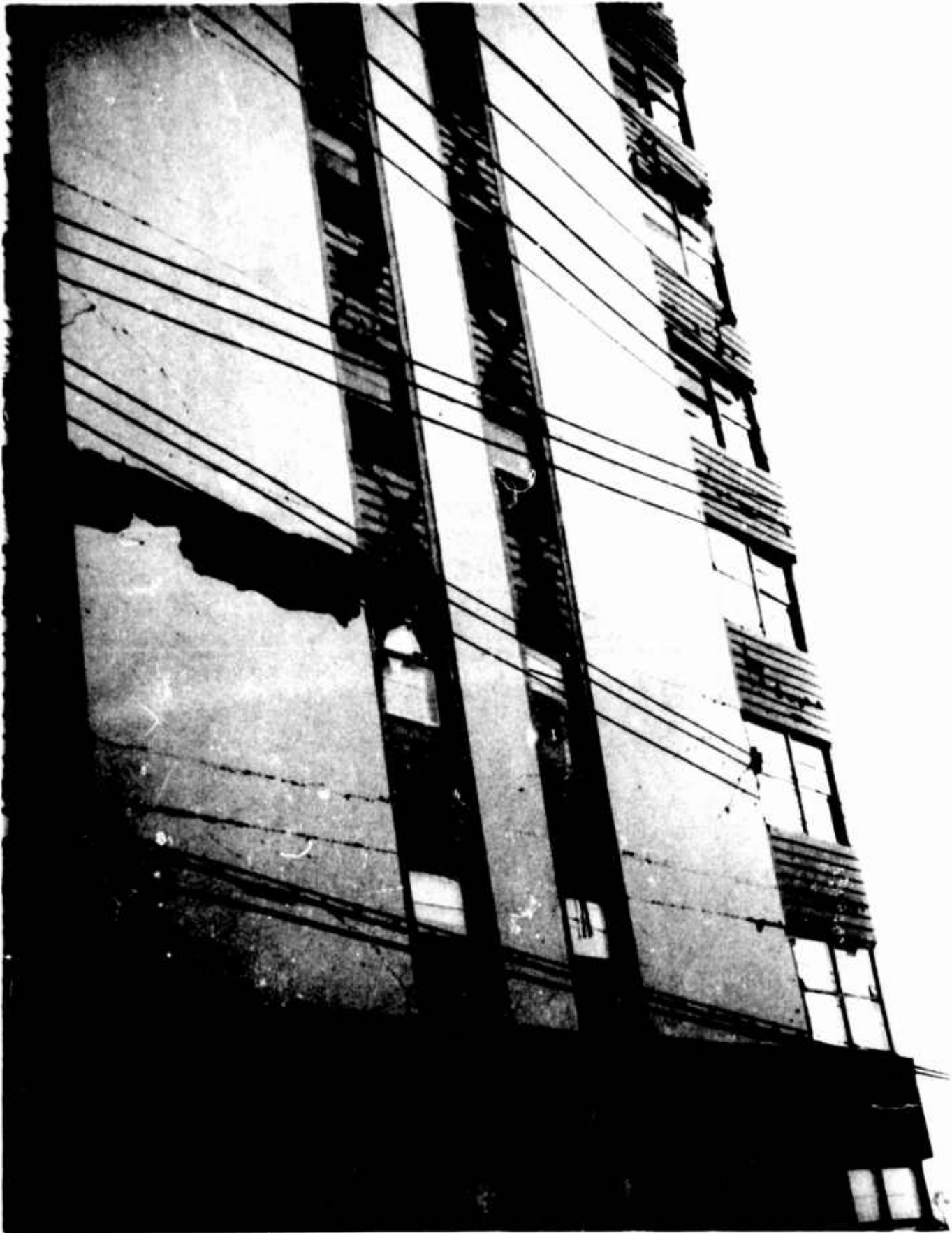


Figure 148. Mount McKinley Building (Exterior closeup of column wall fractures)

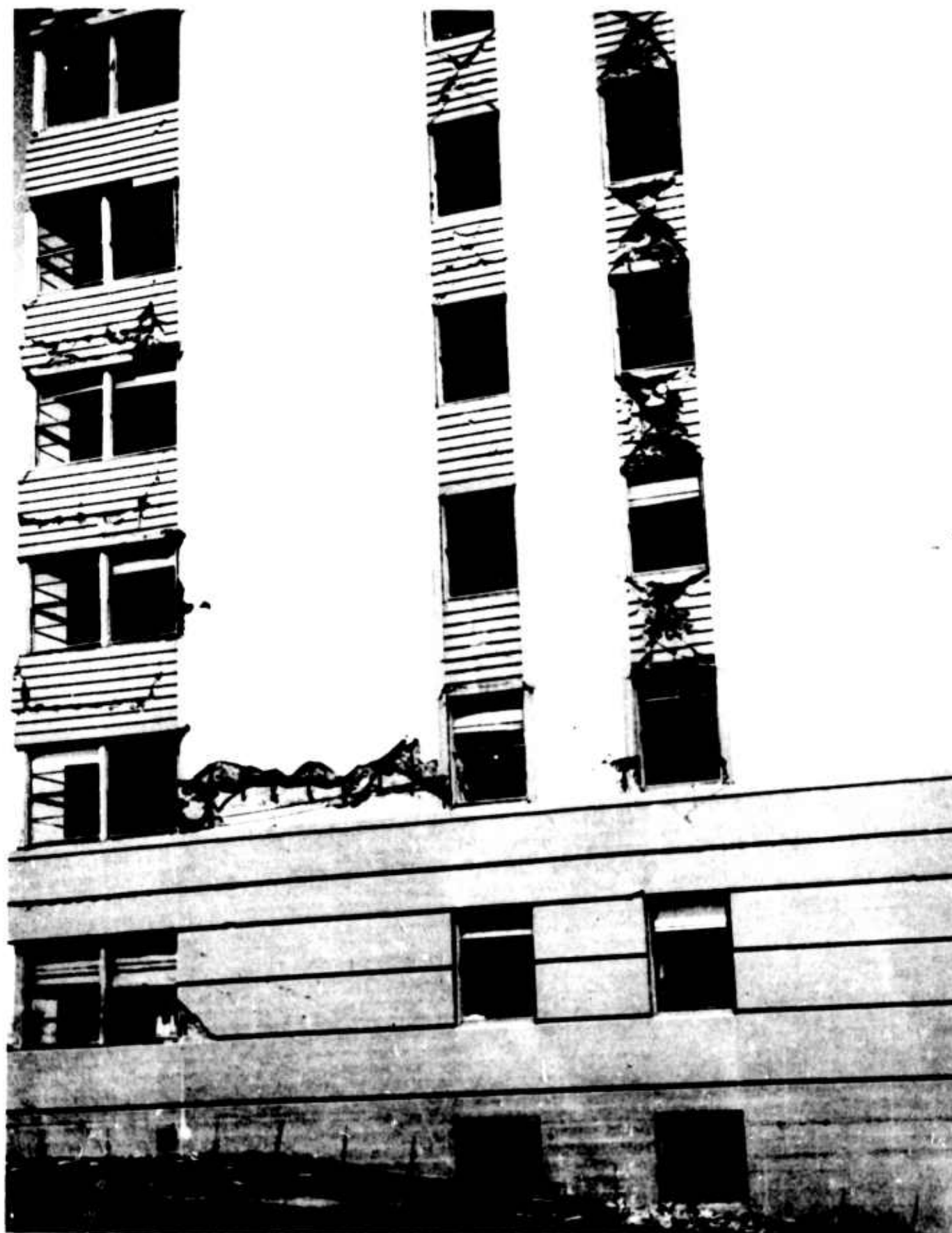


Figure 149. Twelve-Hundred L Street Apartments
(Exterior closeup of column wall fracture)



Figure 150. Mount McKinley Building (Interior closeup of column wall fracture)

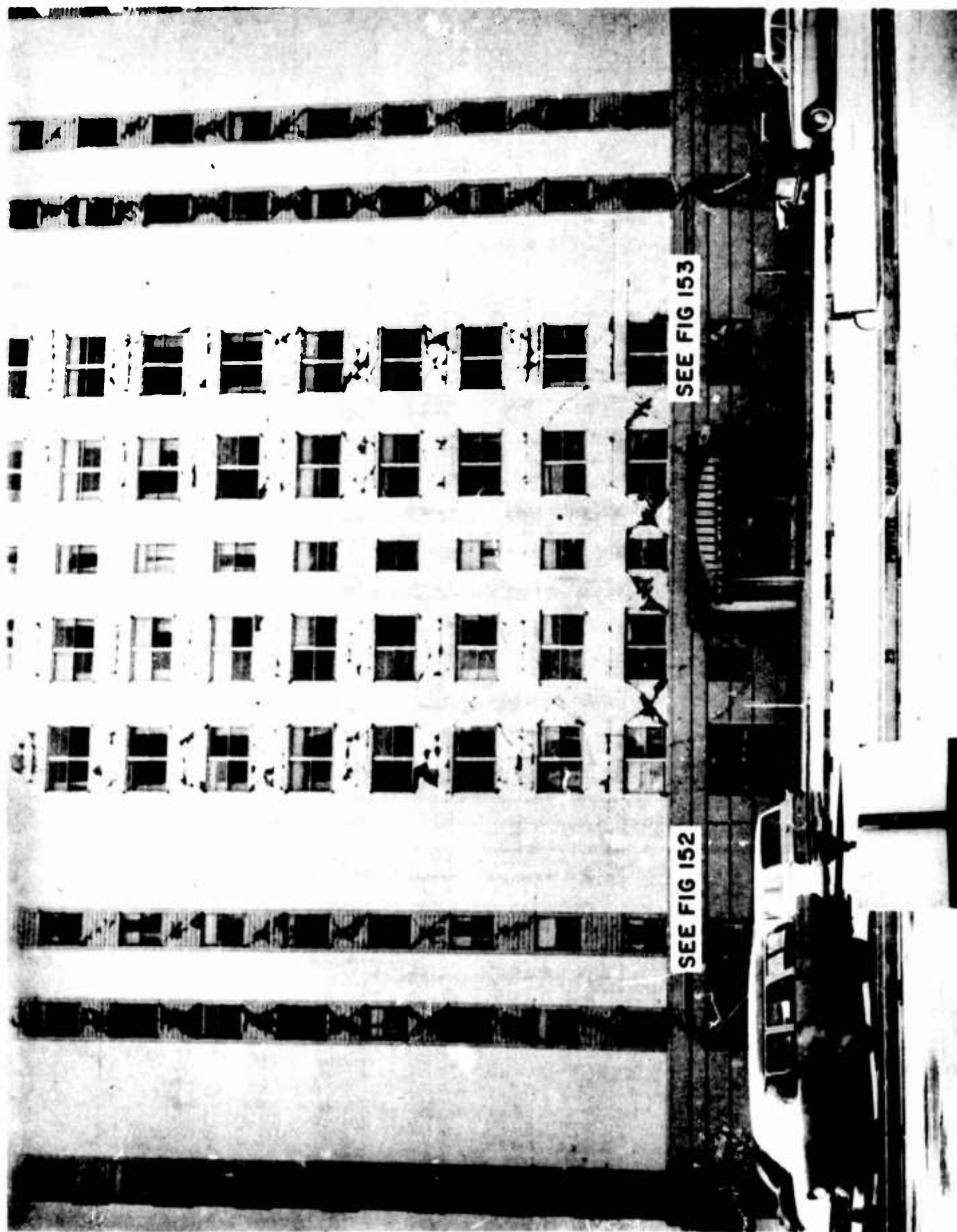


Figure 151. Mount McKinley Building
(East wall of structure showing major diagonal tension failures of second-floor level)



Figure 152. Mount McKinley Building
(Diagonal tension failure in east wall at second-floor level)



Figure 153. Mount McKinley Building (Diagonal tension failure in east wall at second-floor level)

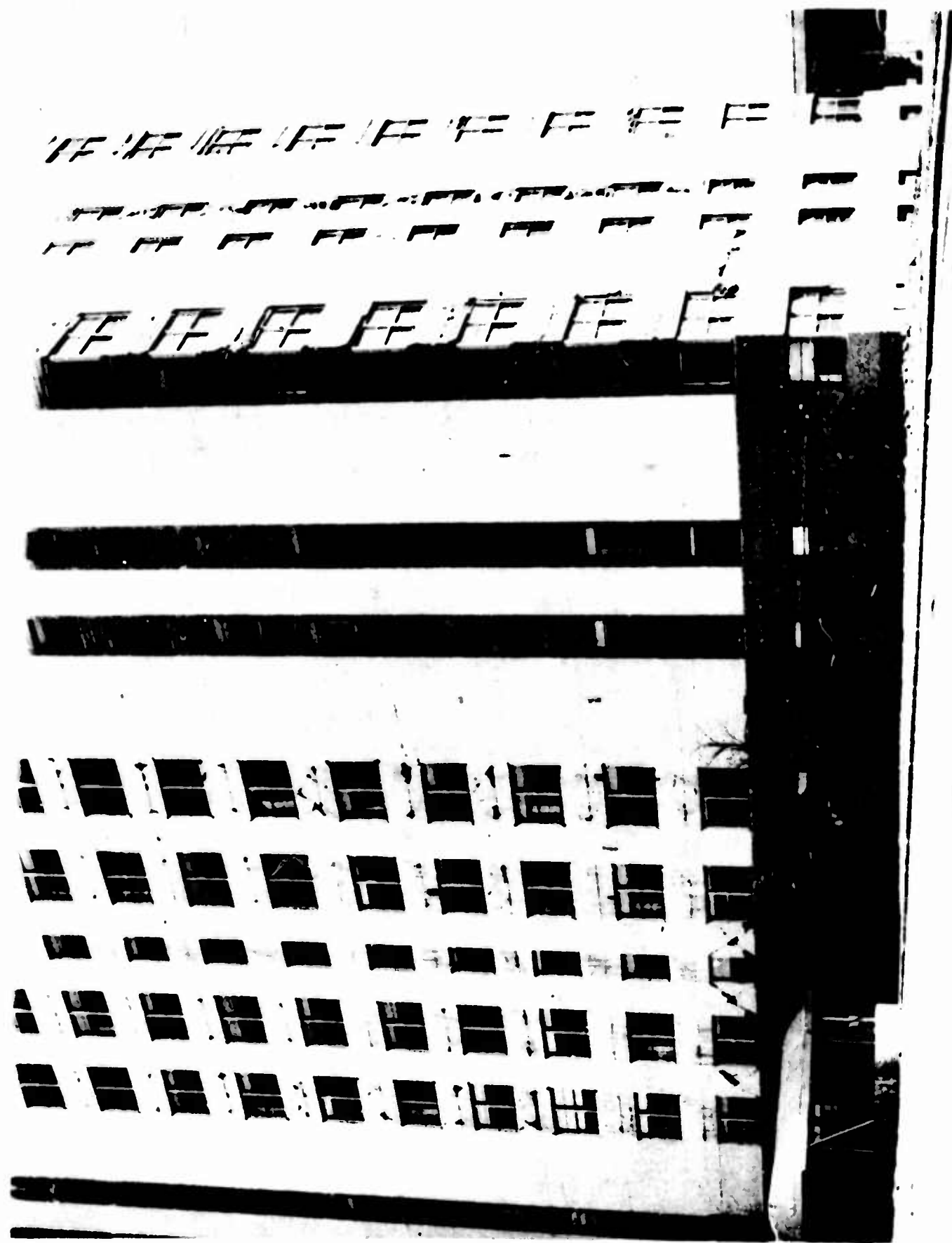


Figure 154. Twelve-Hundred L Street Apartments (West wall of structure showing absence of major diagonal tension failures at second-floor level which occurred in the Mount McKinley Building)



Figure 155. Mount McKinley Building (Shortened column in south wall near southeast corner of structure)

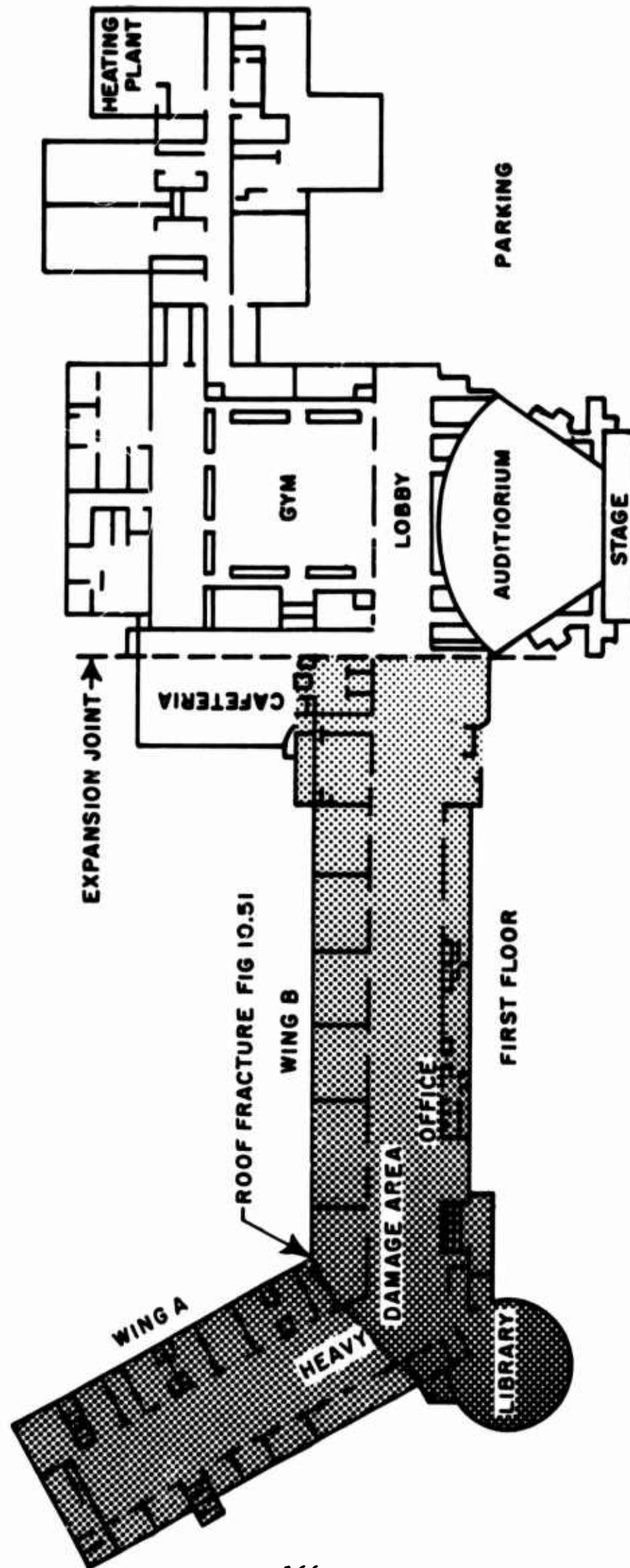


Figure 156. West Anchorage High School (Plan view)



Figure 157. West Anchorage High School (Aerial view after the quake)



Figure 158. West Anchorage High School (Main entrance showing basic flat slab structural system with roof and second-floor spandrel beams)



Figure 159. West Anchorage High School
(Damage to wing B and intersection of wings A and B)



Figure 160. West Anchorage High School (Roof slab fracture near the intersection of wings A and B. Temperature reinforcing normal to the fracture has been sheared.)



Figure 161. West Anchorage High School (Damage at intersection of wings A and B)

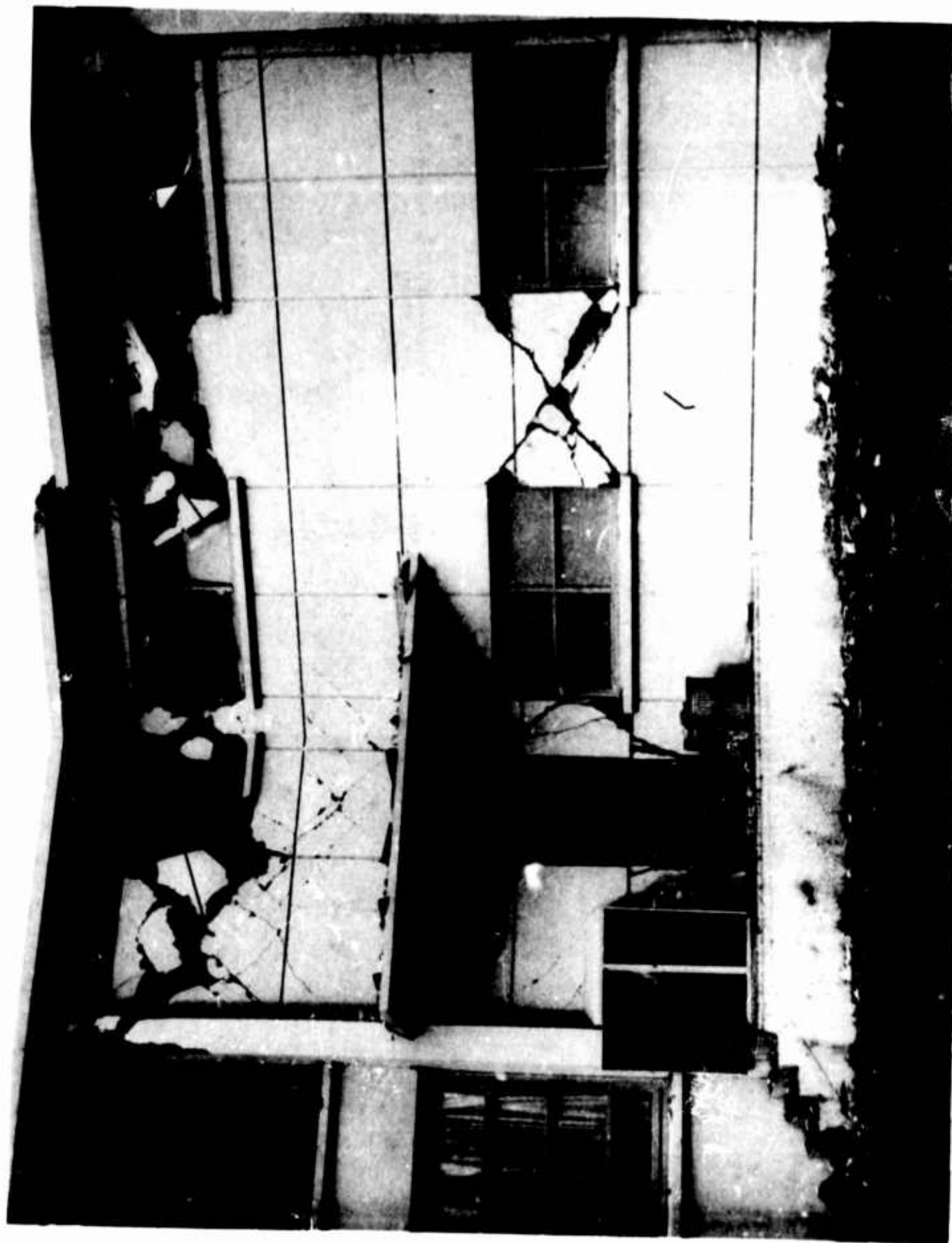


Figure 162. West Anchorage High School (Damage at intersection of wings A and B)

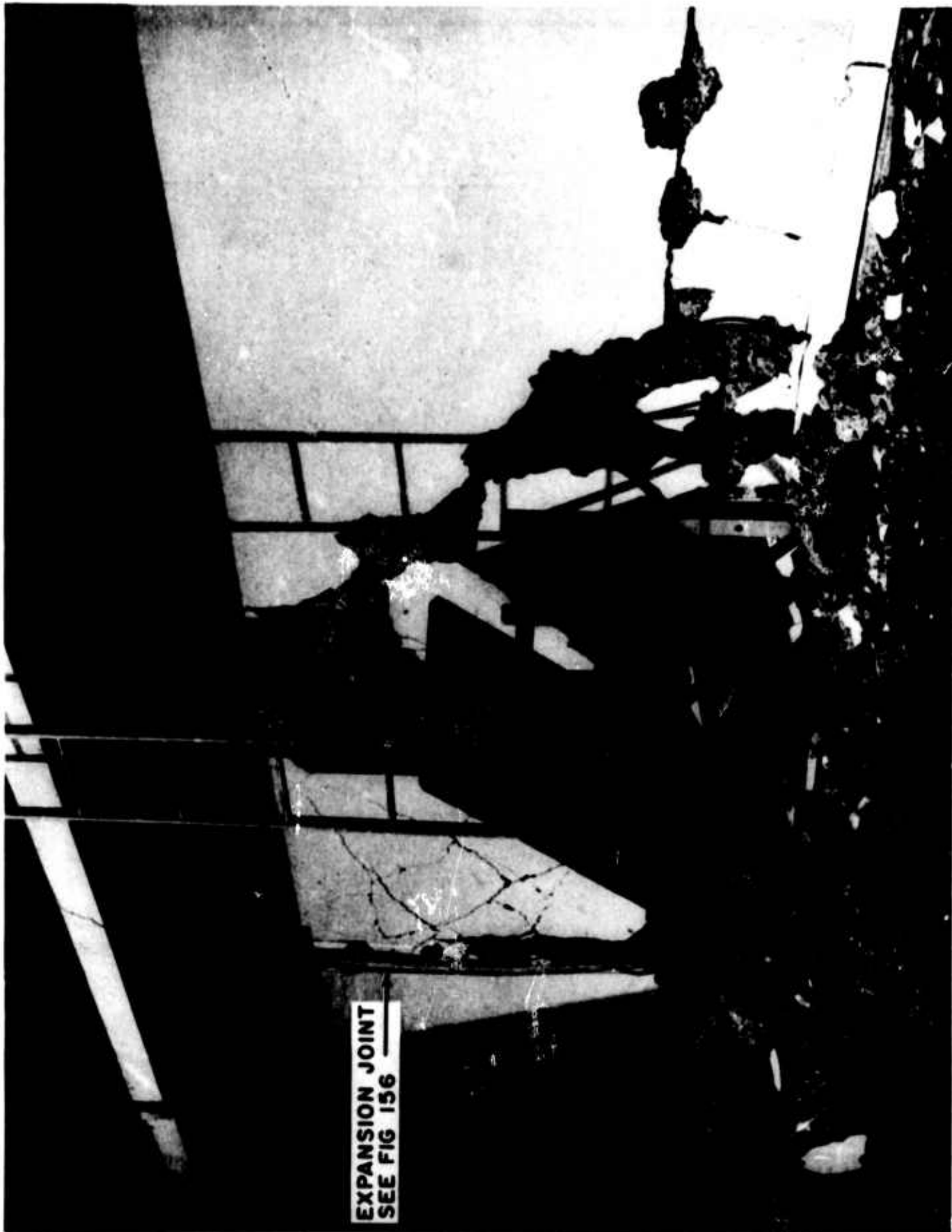


Figure 163. West Anchorage High School (Damage to wing B near expansion joint between wing B and auditorium/gymnasium structure)

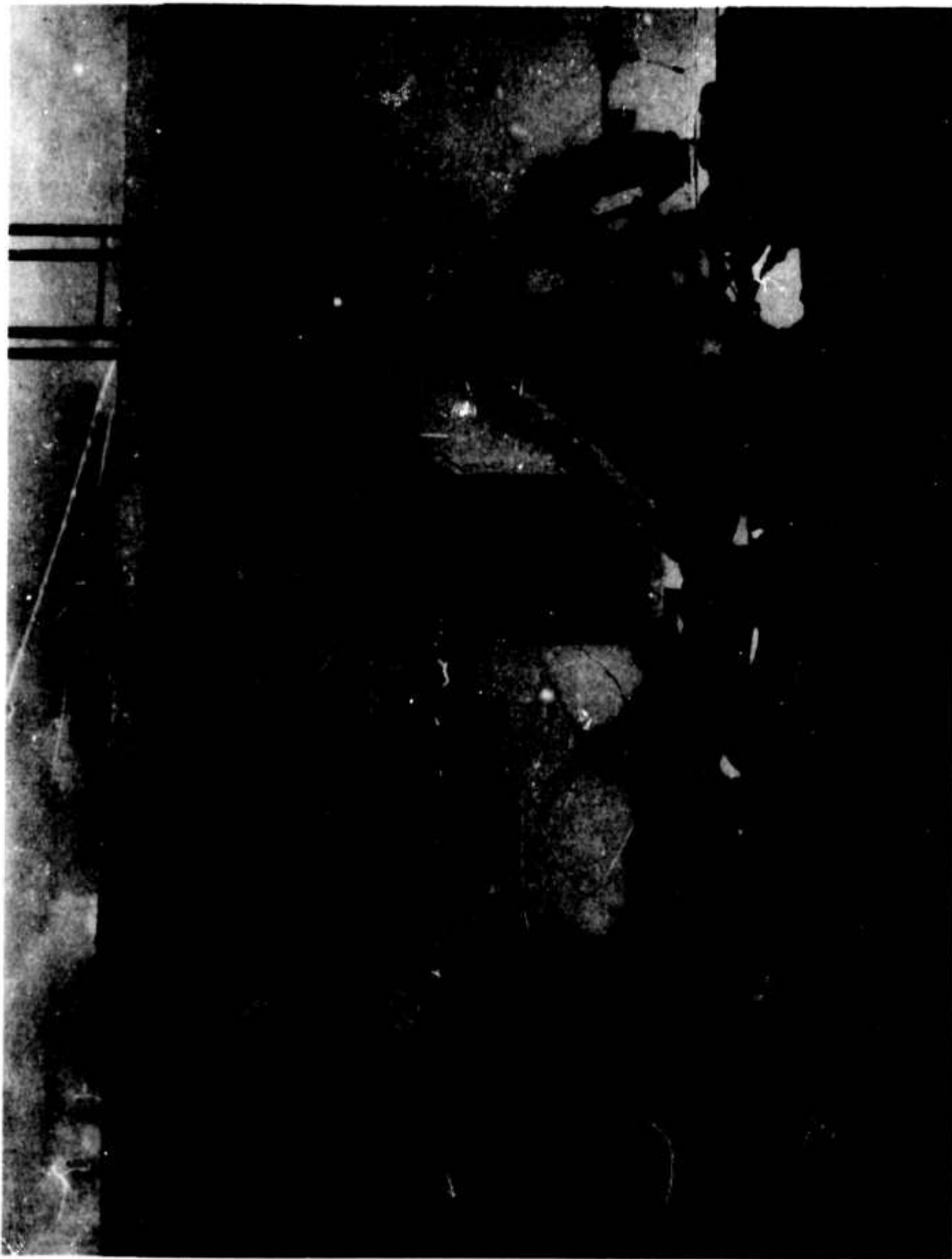


Figure 164. West Anchorage High School (Damage to wing B near expansion joint
between wing B and auditorium/gymnasium structure)

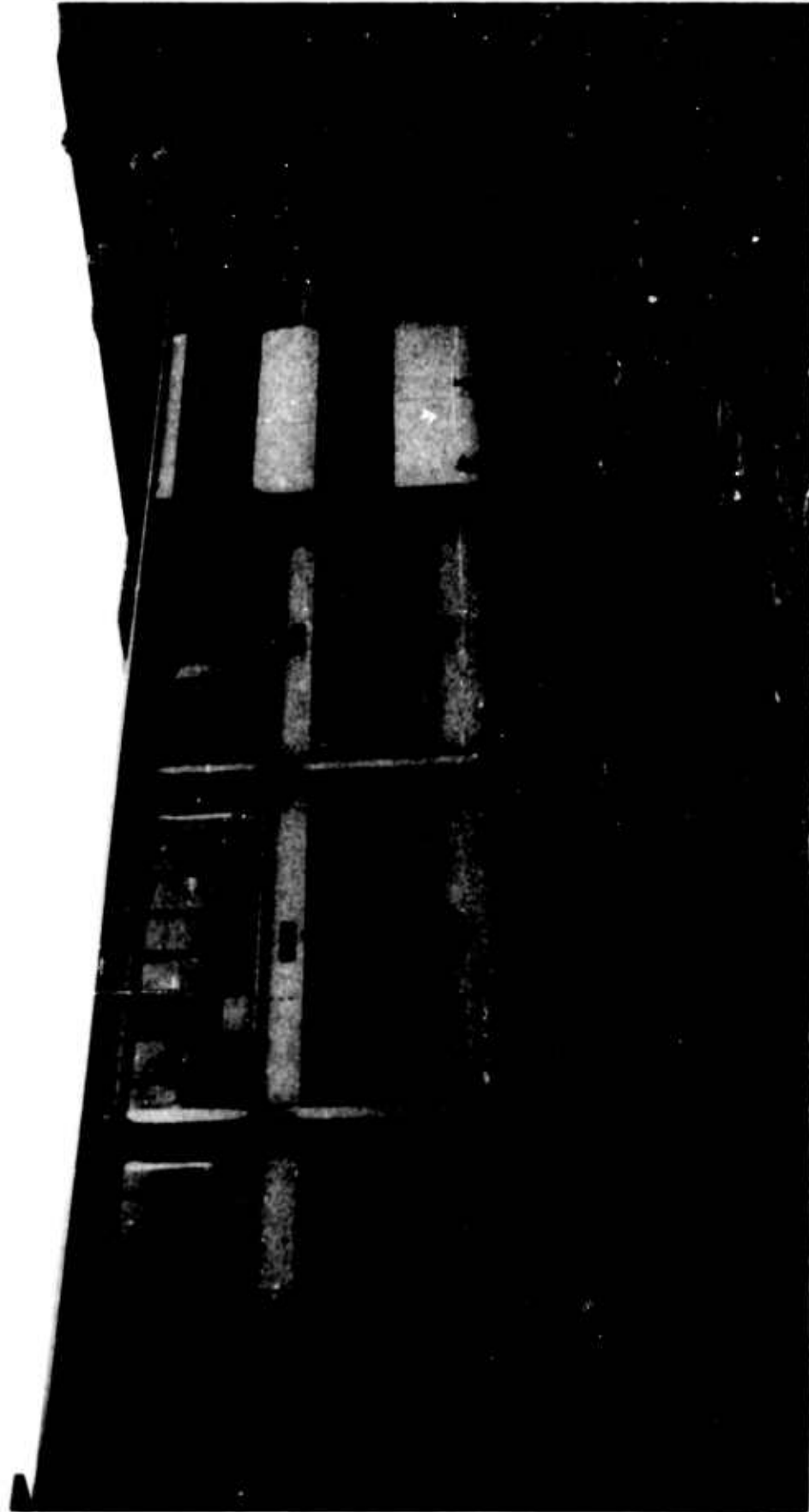


Figure 165. West Anchorage High School (North Side of wing B near expansion joint between wing B and auditorium/gymnasium structure)

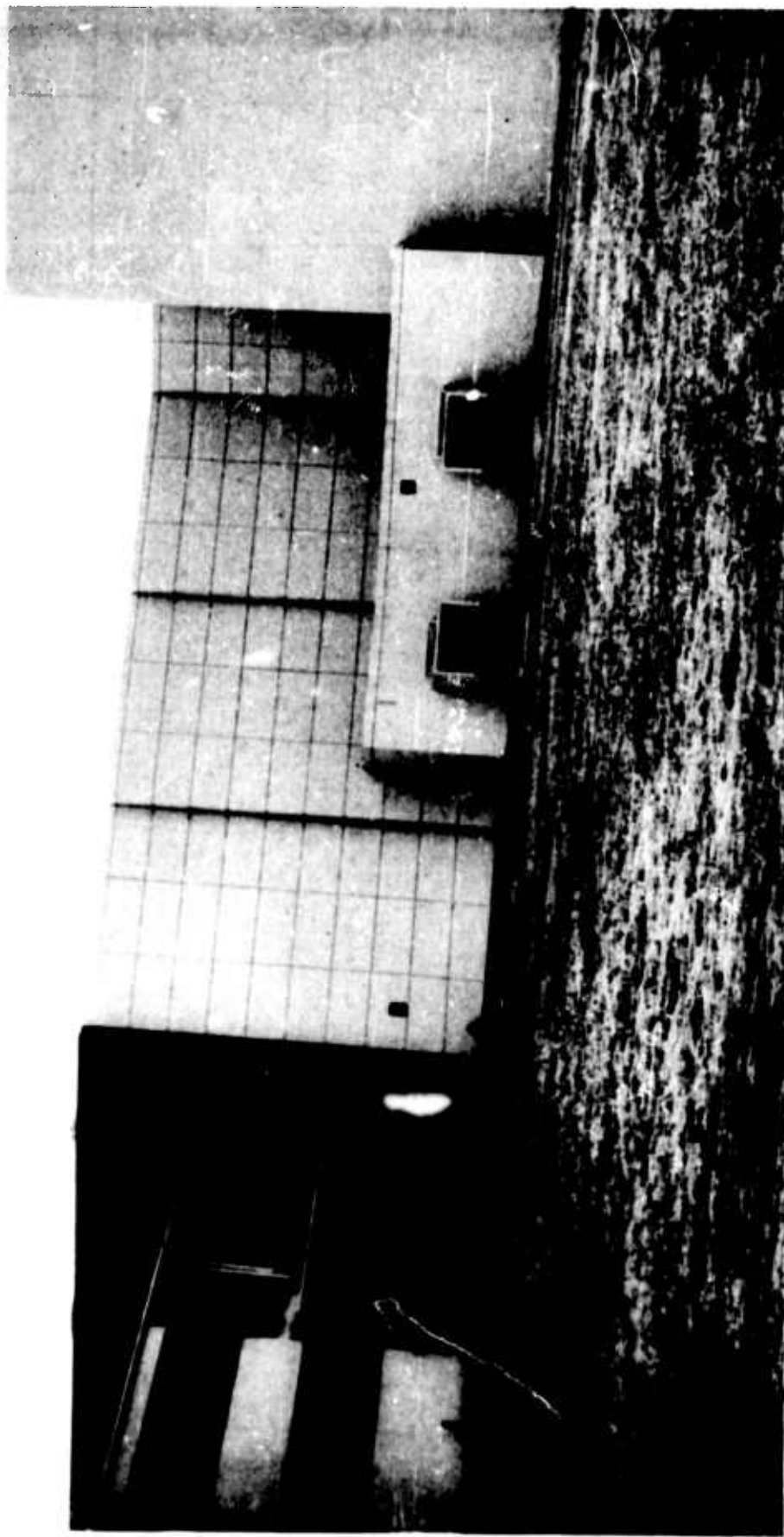


Figure 166. West Anchorage High School (East wall of undamaged auditorium)



Figure 167. West Anchorage High School (West wall of wing A showing expansion joint between original wing and later addition)

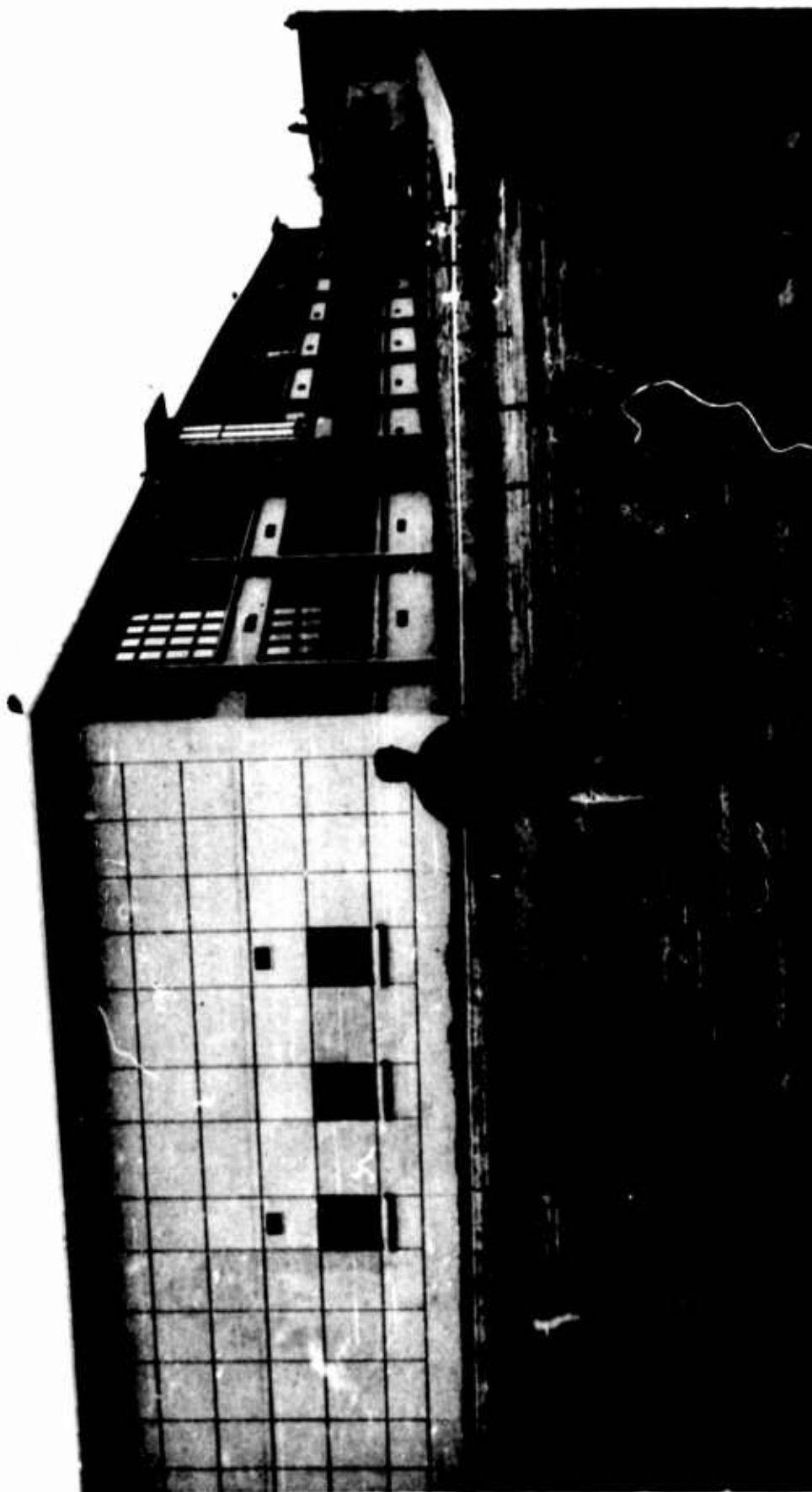


Figure 168. West Anchorage High School (South wall of wing A addition)

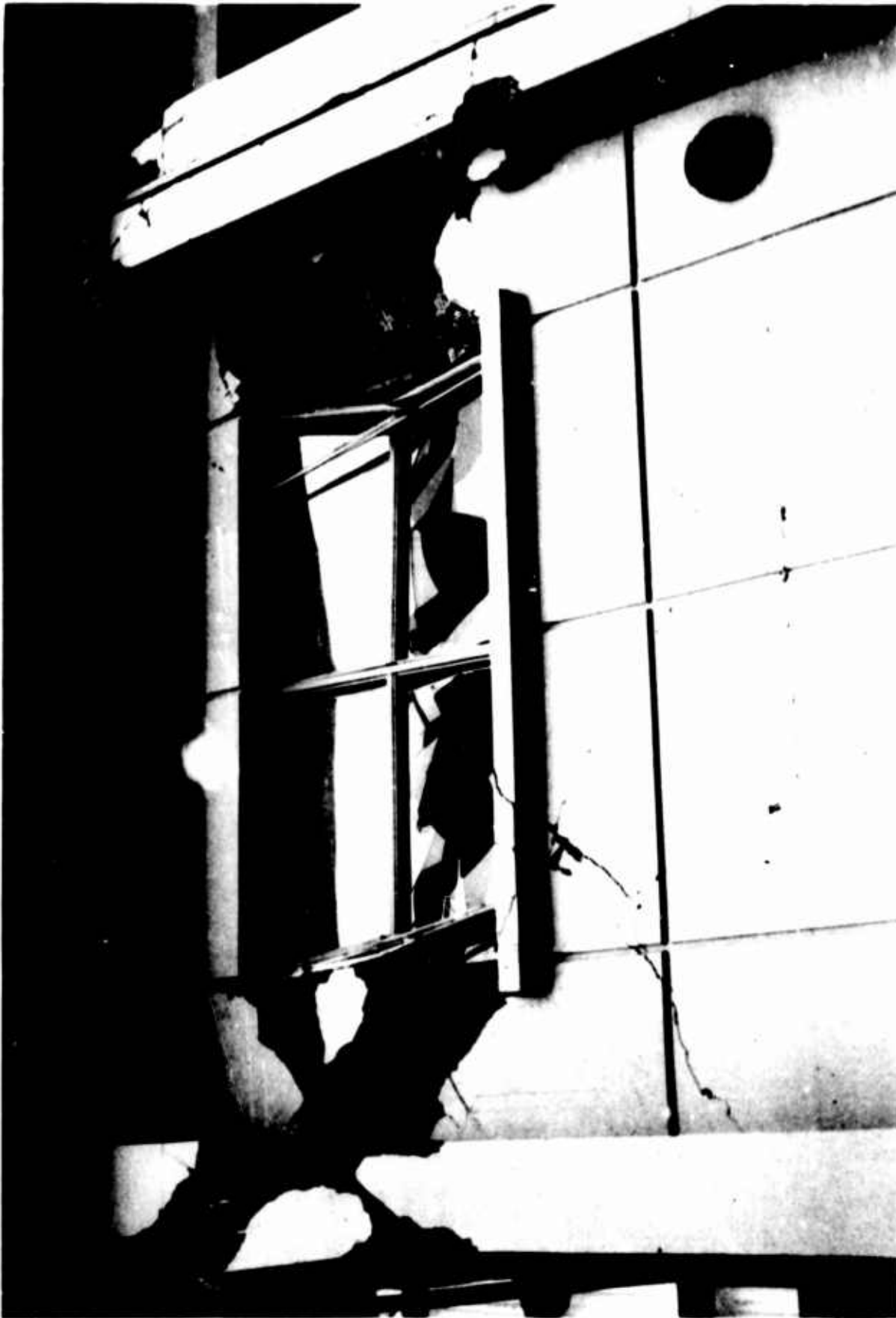


Figure 169. West Anchorage High School
(Damage to second-story wall of wing A adjacent to wing A addition)

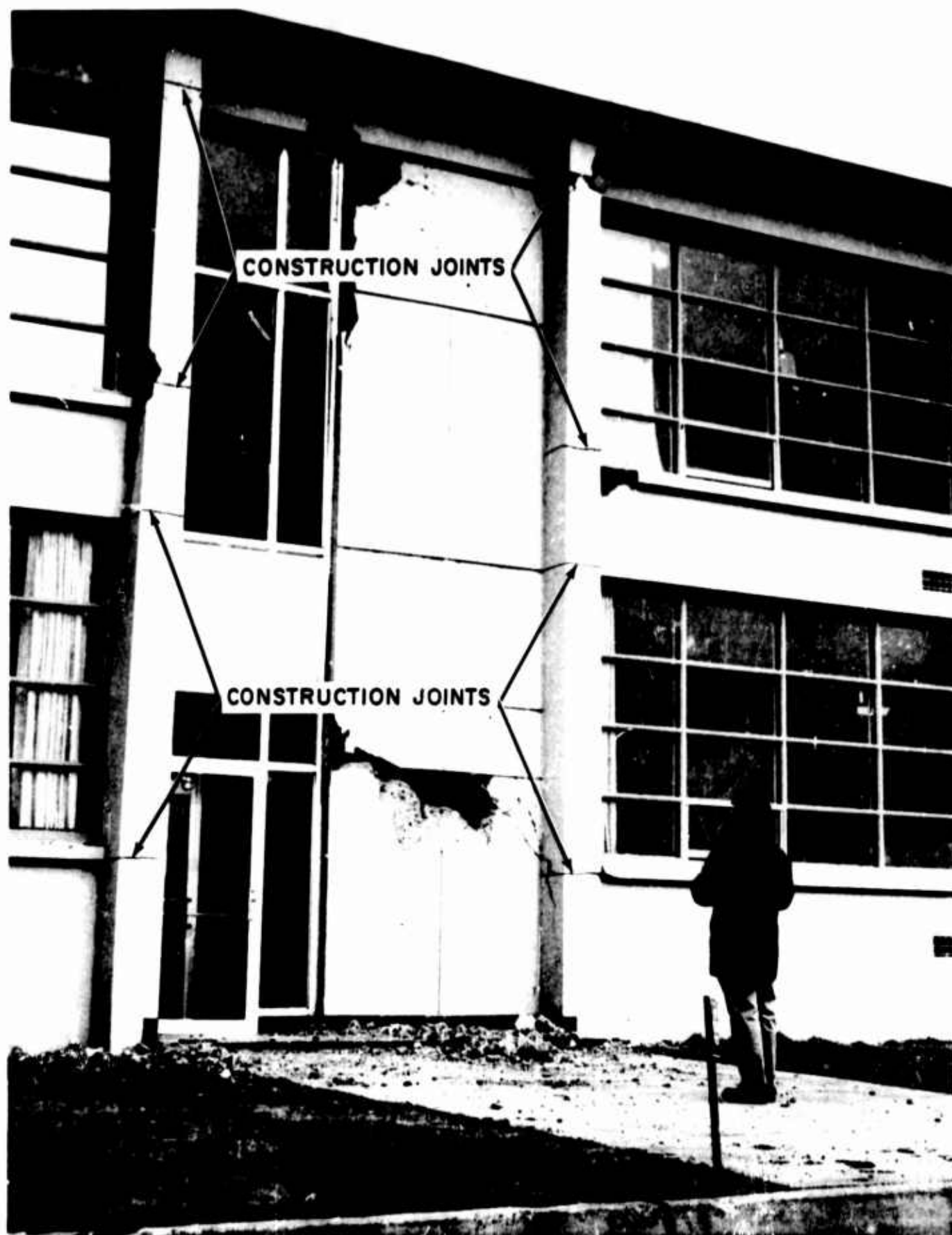


Figure 170. West Anchorage High School
(Damage to wing A addition near expansion joint
between addition and original wing A)

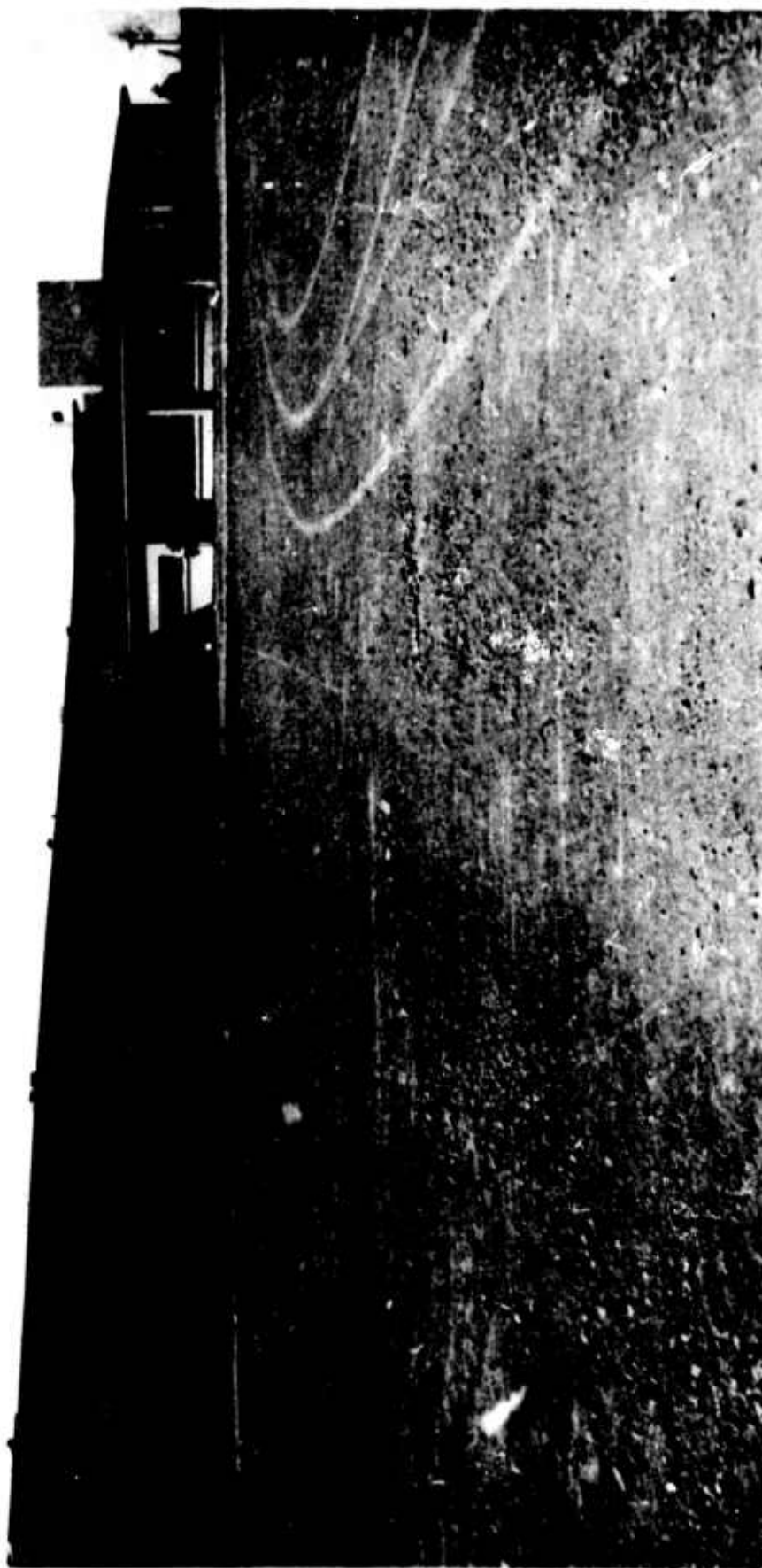


Figure 171. West Anchorage High School (East wall of wing A and library)

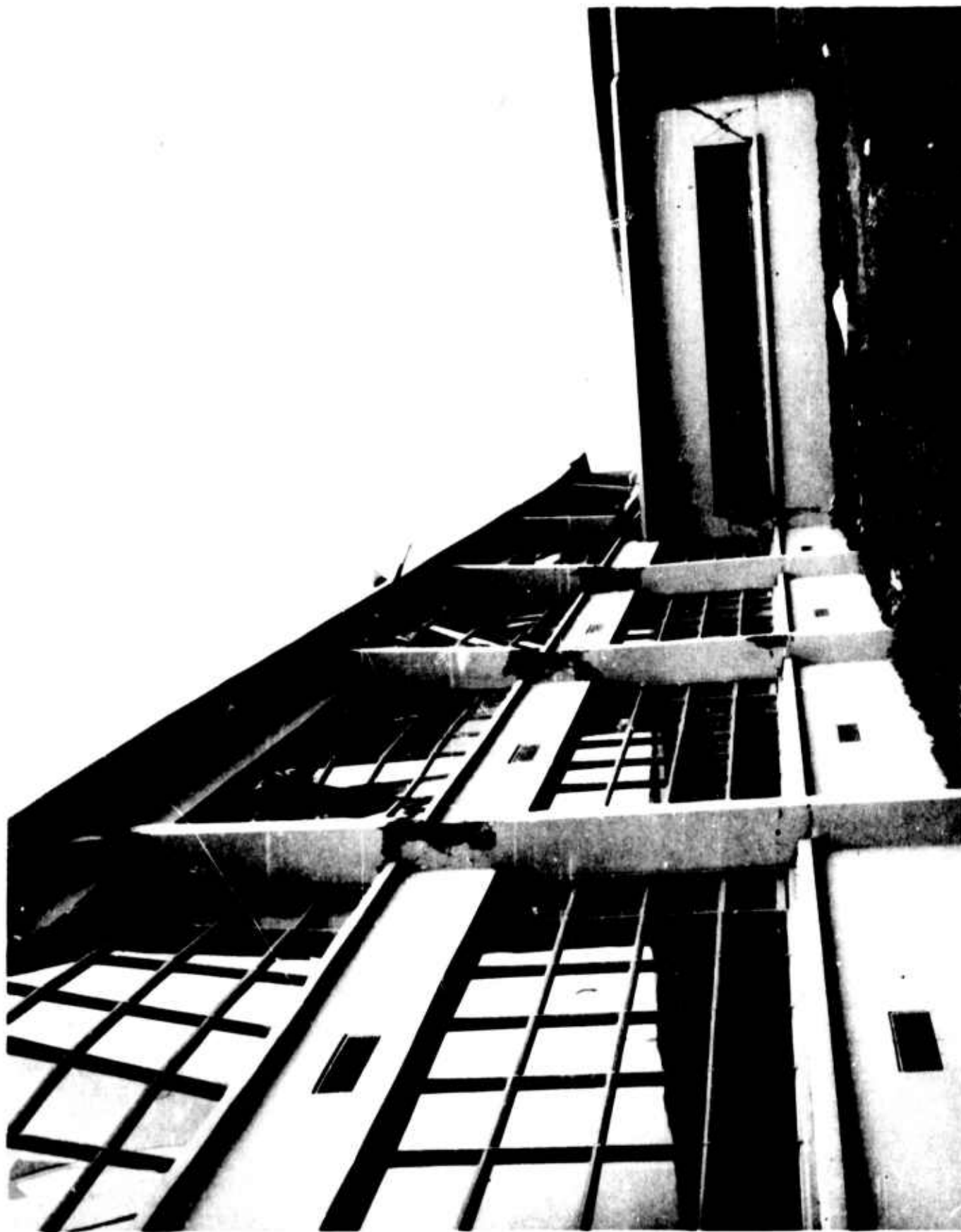


Figure 172. West Anchorage High School (Column damage in east wall of wing A near the library)



Figure 173. West Anchorage High School (The library received relatively minor damage.)

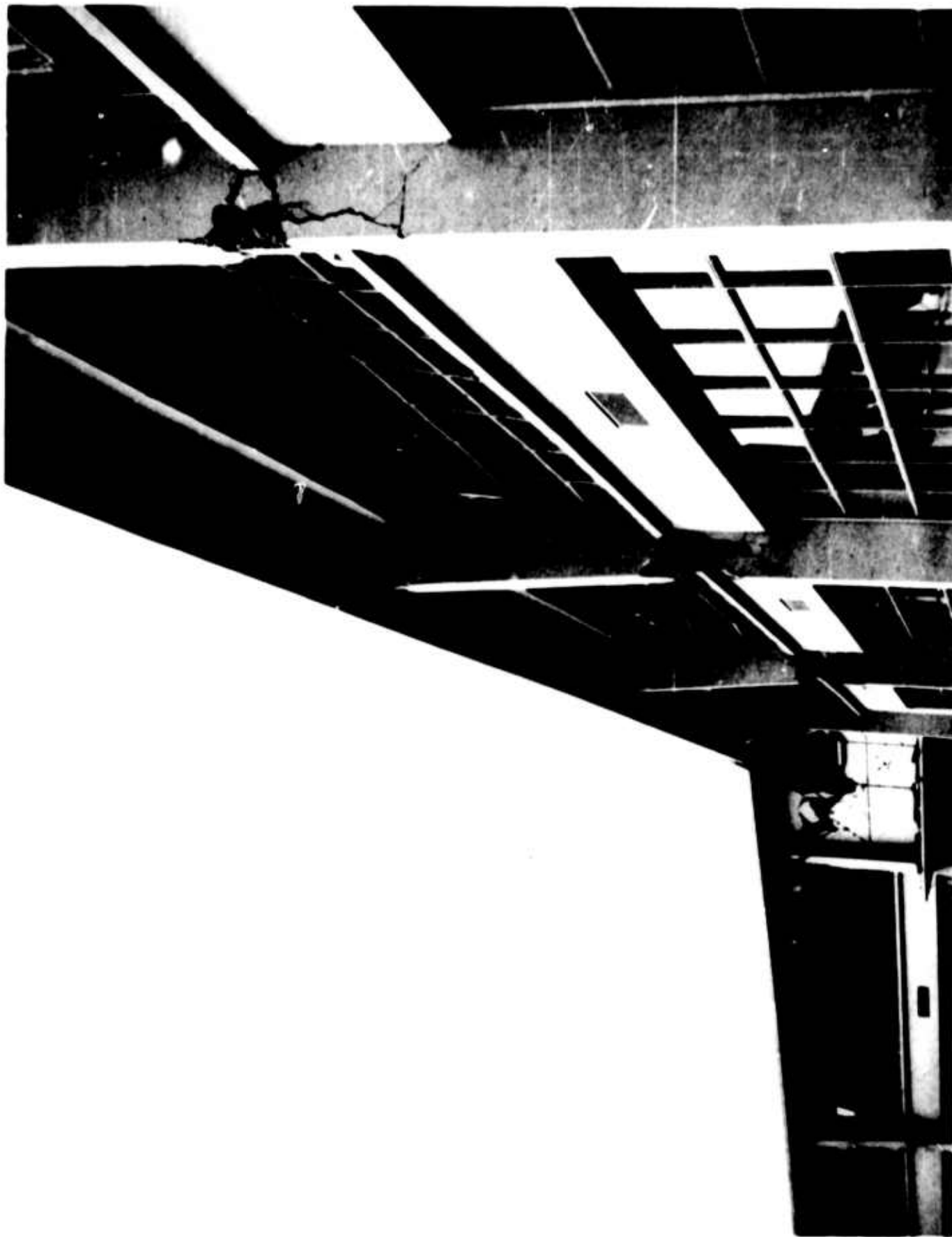


Figure 174. West Anchorage High School (Damage to second-story columns in west wall of wing A near intersection of wings A and B showing consistently poor column construction joints)



Figure 175. West Anchorage High School
(Closeup of damaged column shown in figure 174)



Figure 176. West Anchorage High School
(Closeup of damaged column shown in figure 174)

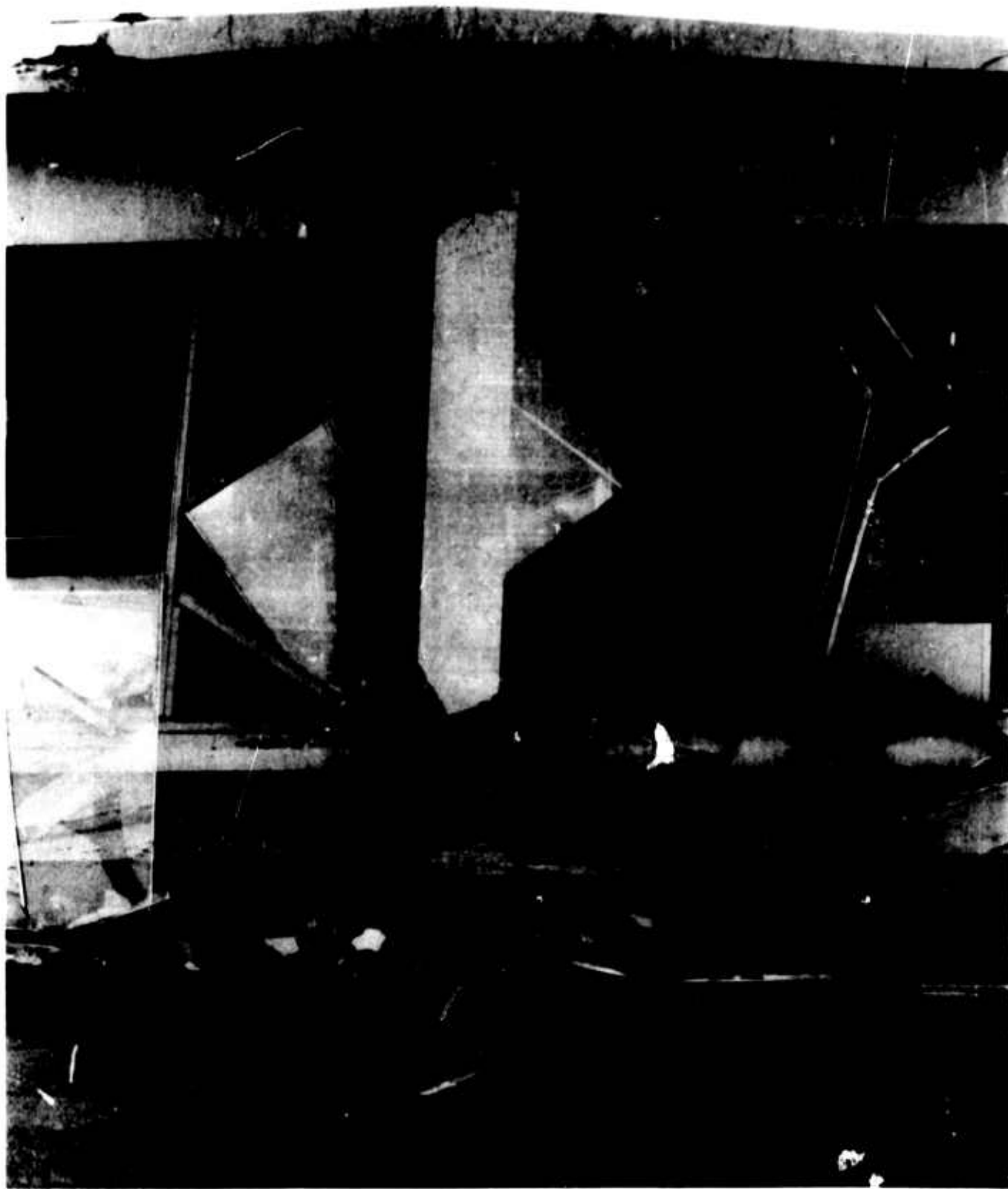


Figure 177. West Anchorage High School
(Failed column in east wall of wing A near roof
fracture, taken from library roof)

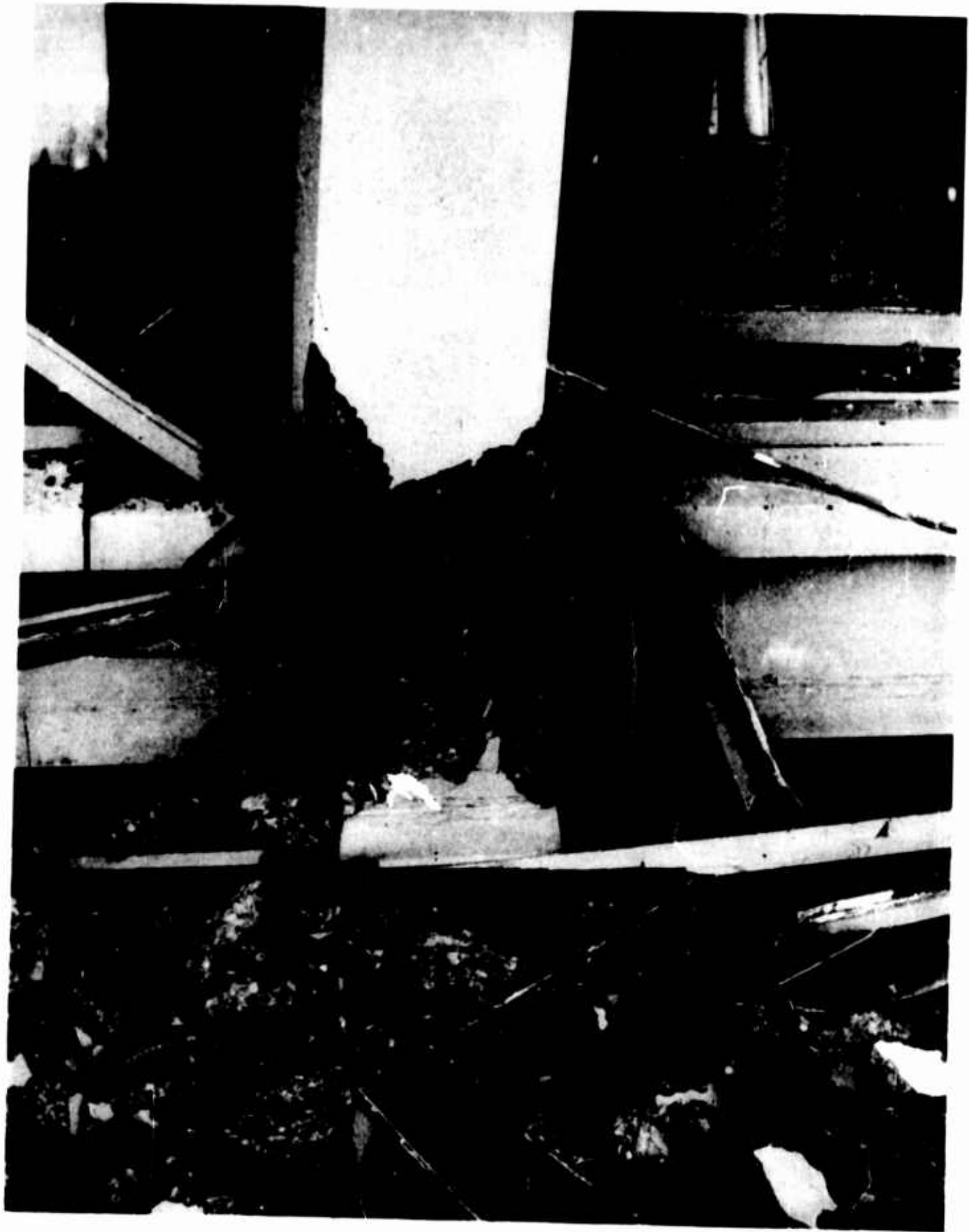


Figure 178. West Anchorage High School
(Closeup of the base of the column shown in figure 177)

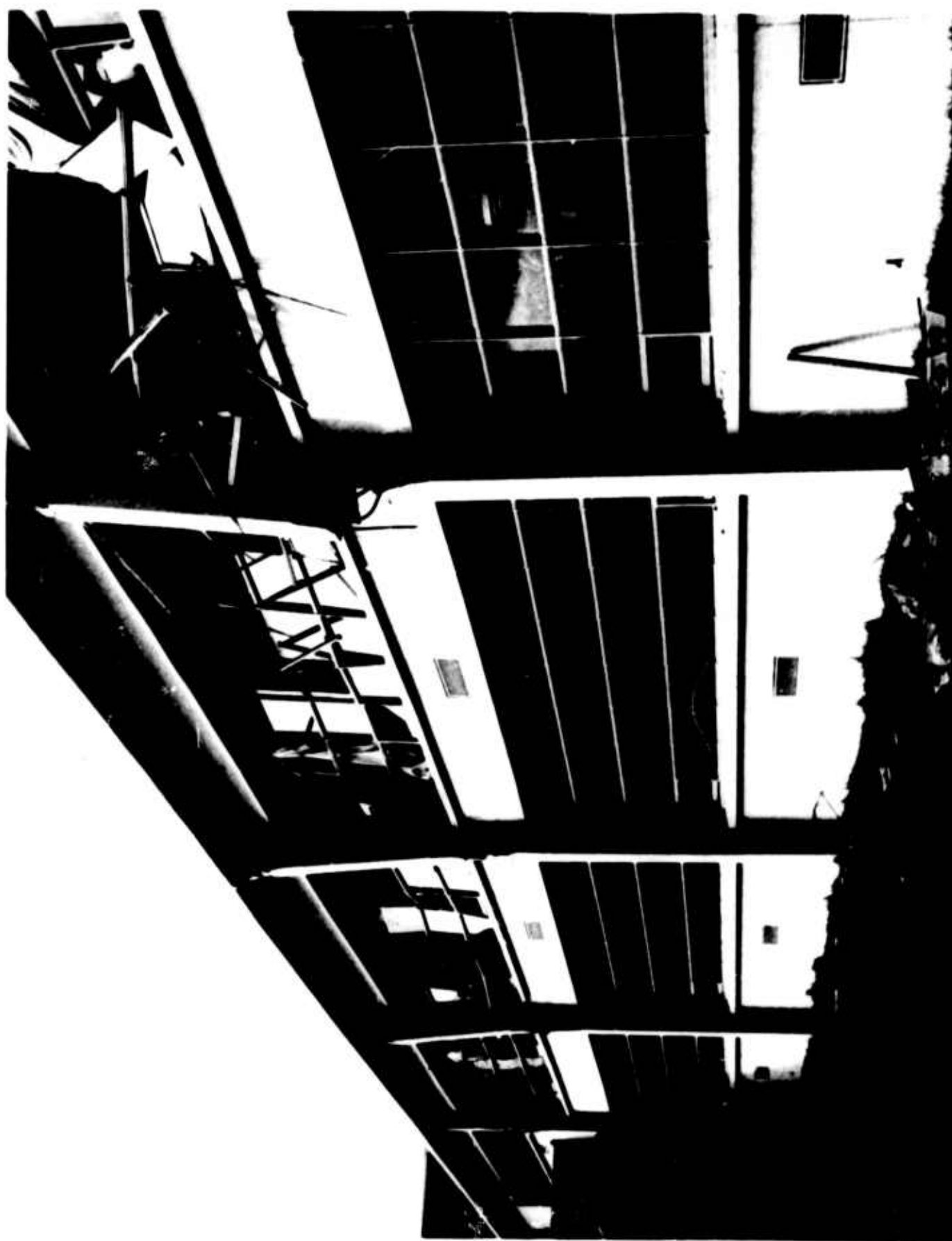


Figure 179. West Anchorage High School (Damage to second-story columns in south wall of wing B)



Figure 180. West Anchorage High School
(Complete fracture of a second-story column in south wall of wing B.
The reinforcing steel is bent but not broken.)



Figure 181. West Anchorage High School
(No horizontal ties are visible at the base of the column shown in figure 180)



Figure 182. West Anchorage High School
(Damage to short second-story column in south wall of wing B
above the cafeteria was not prevented by light horizontal ties)



Figure 183. West Anchorage High School
(The other side of the column shown in figure 182)



Figure 184. West Anchorage High School (Interior damage to second-floor classroom on south side of wing B)



Figure 185. Reed Building (North side of the structure showing effects of previous earthquake damage as well as remedial measures taken to repair recent damage)



Figure 186. Reed Building (Steel straps secure southwest corner of building)



Figure 187. Four Seasons Apartments (West side of unoccupied six-story structure before the quake)

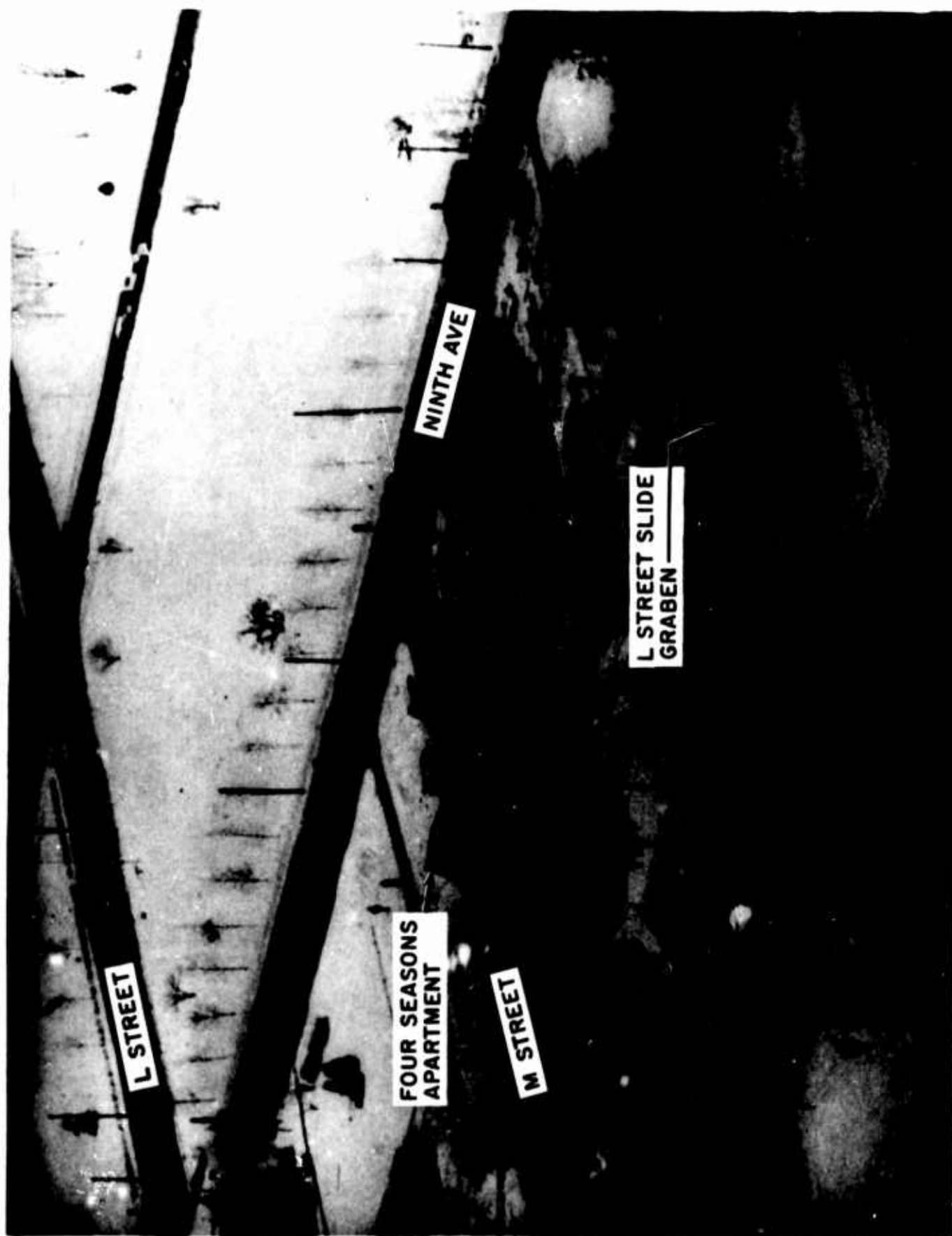


Figure 188. Four Seasons Apartments
(Aerial view of collapsed structure, a few yards south of the L Street slide graben)



Figure 189. Four Seasons Apartments
(East side of the collapsed structure showing a portion of the L Street slide graben)



Figure 190. Four Seasons Apartments
(The two elevator towers appear to have fallen on top of collapsed floors and roof of structure)

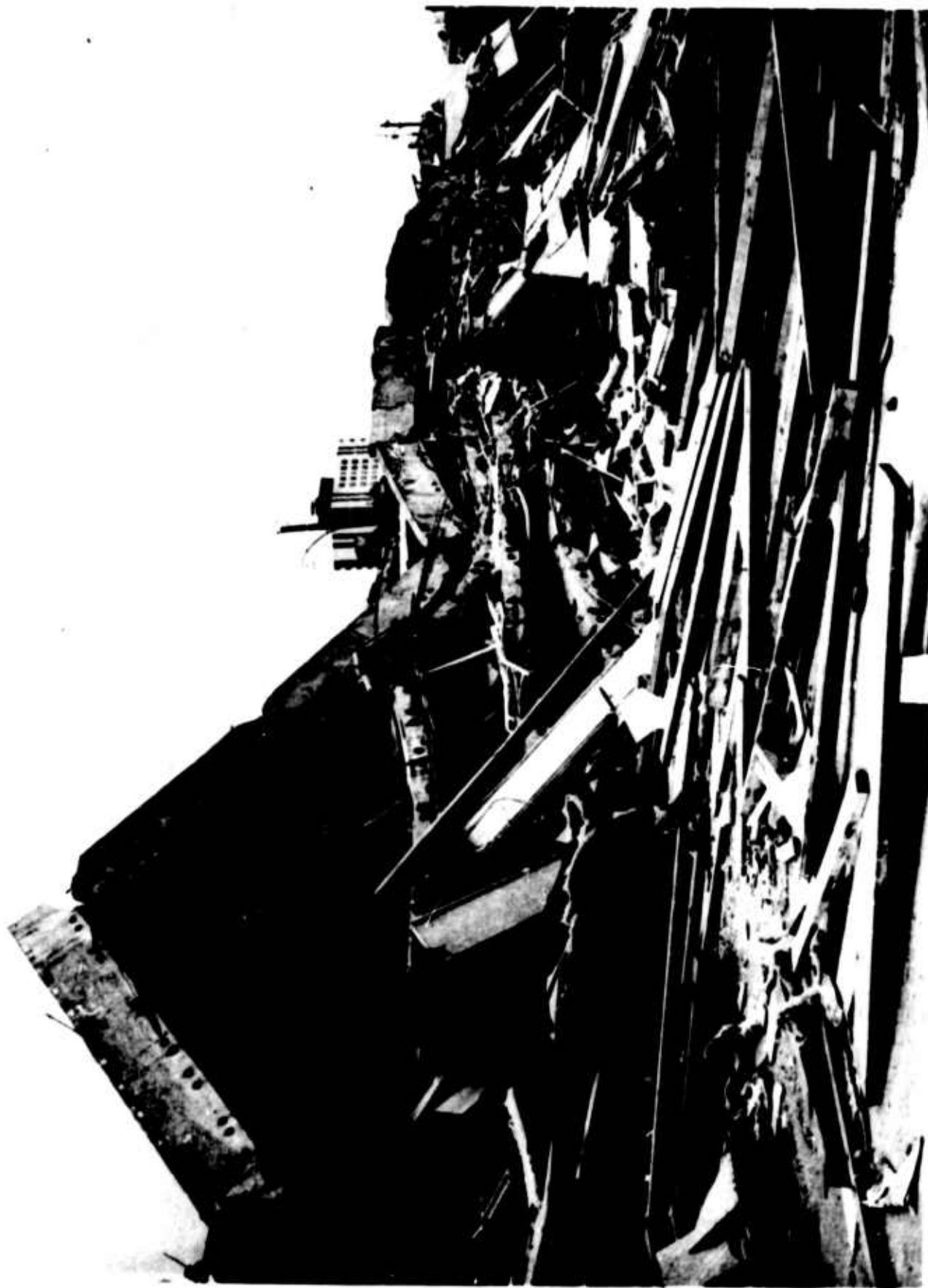


Figure 191. Four Seasons Apartments (Five floors and the roof slid down structural steel columns and assumed a position similar to an early construction phase of the lift slab structure)

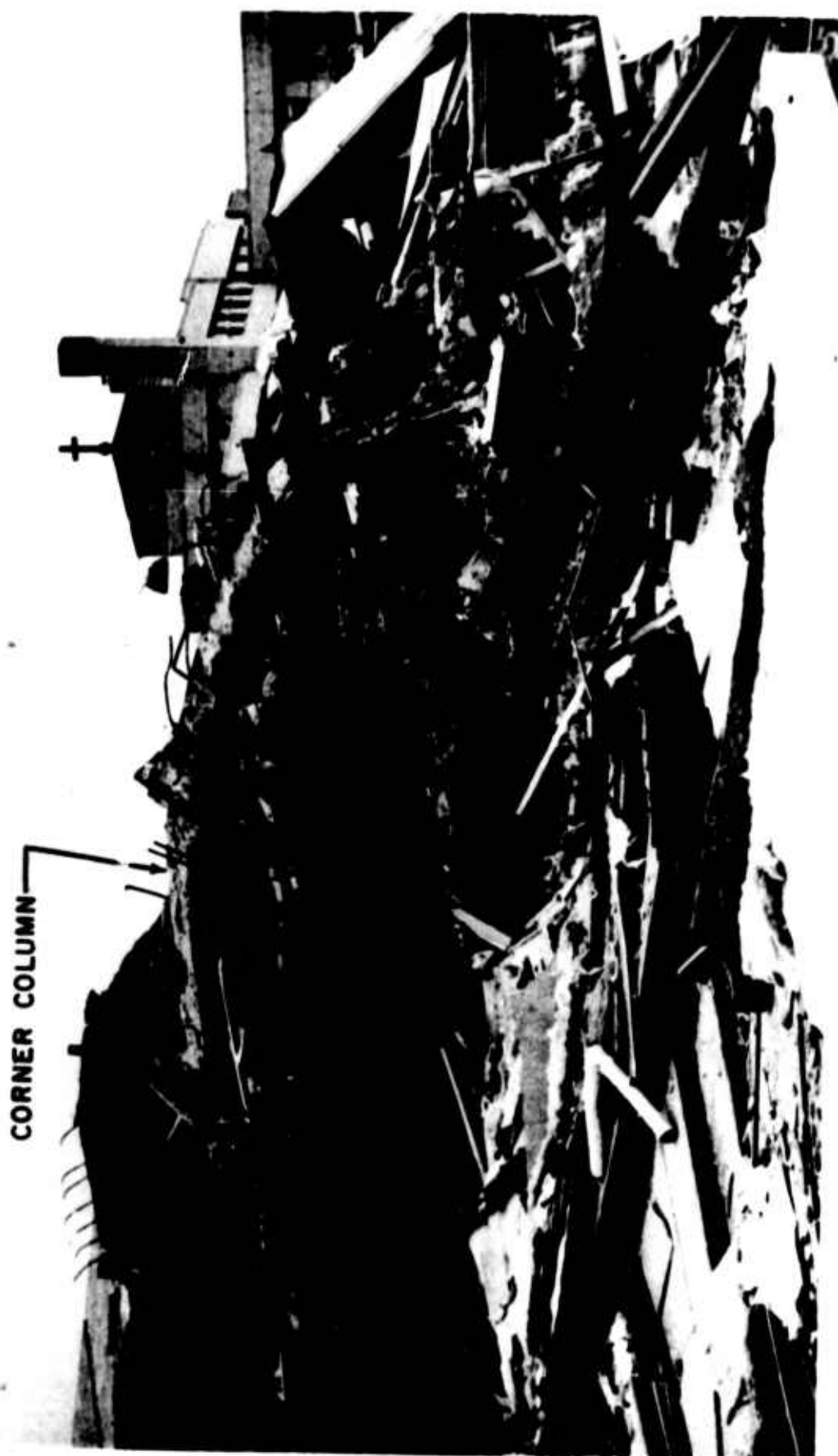


Figure 192. Four Seasons Apartments (The southwest corner column of the structure lay twisted on top of the six prestressed slabs it once helped support)



Figure 193. Four Seasons Apartments (Typical lift slab collar on southwest corner column)

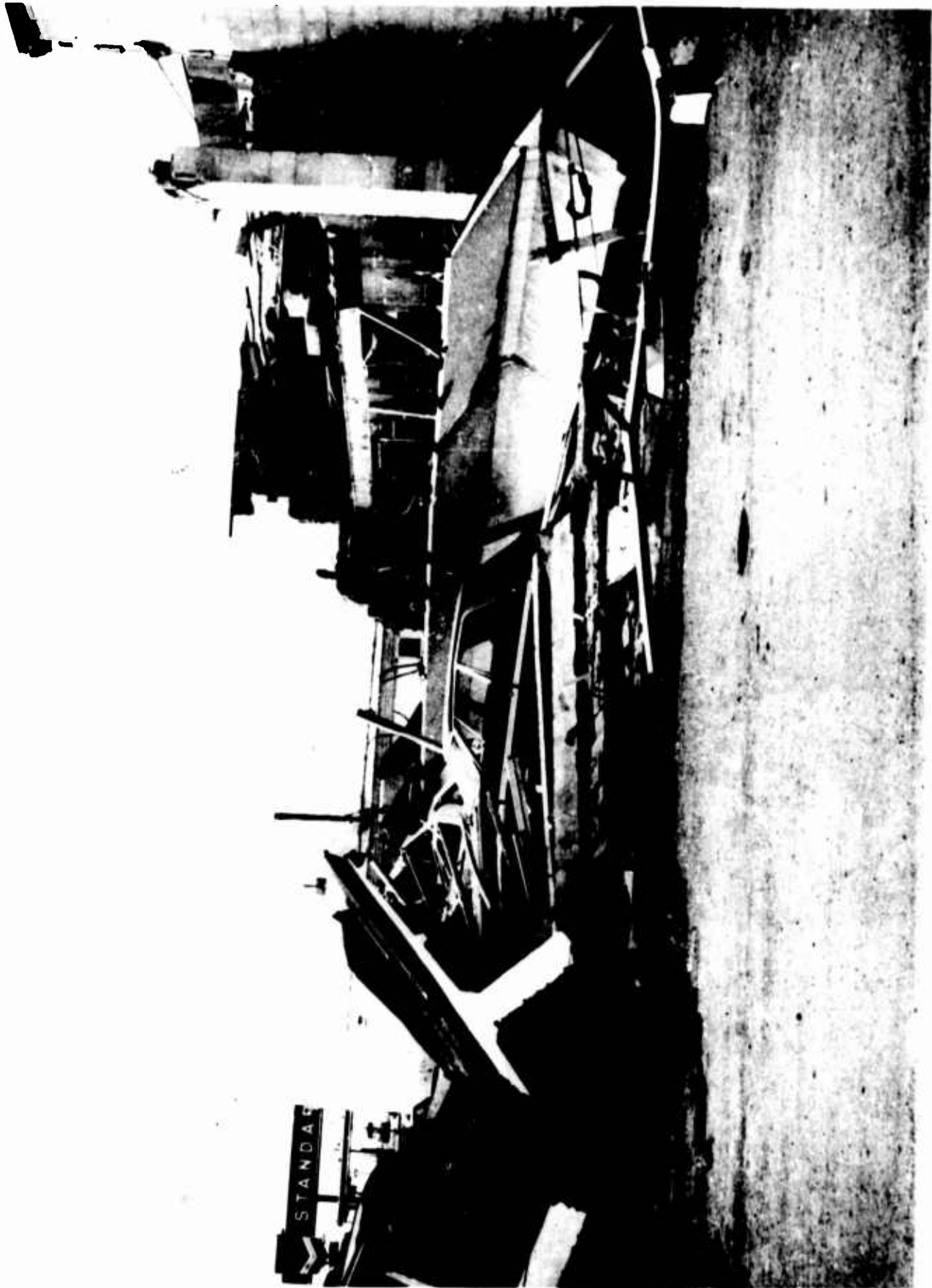


Figure 194. Fifth Avenue Chrysler Center (East side of former showroom)

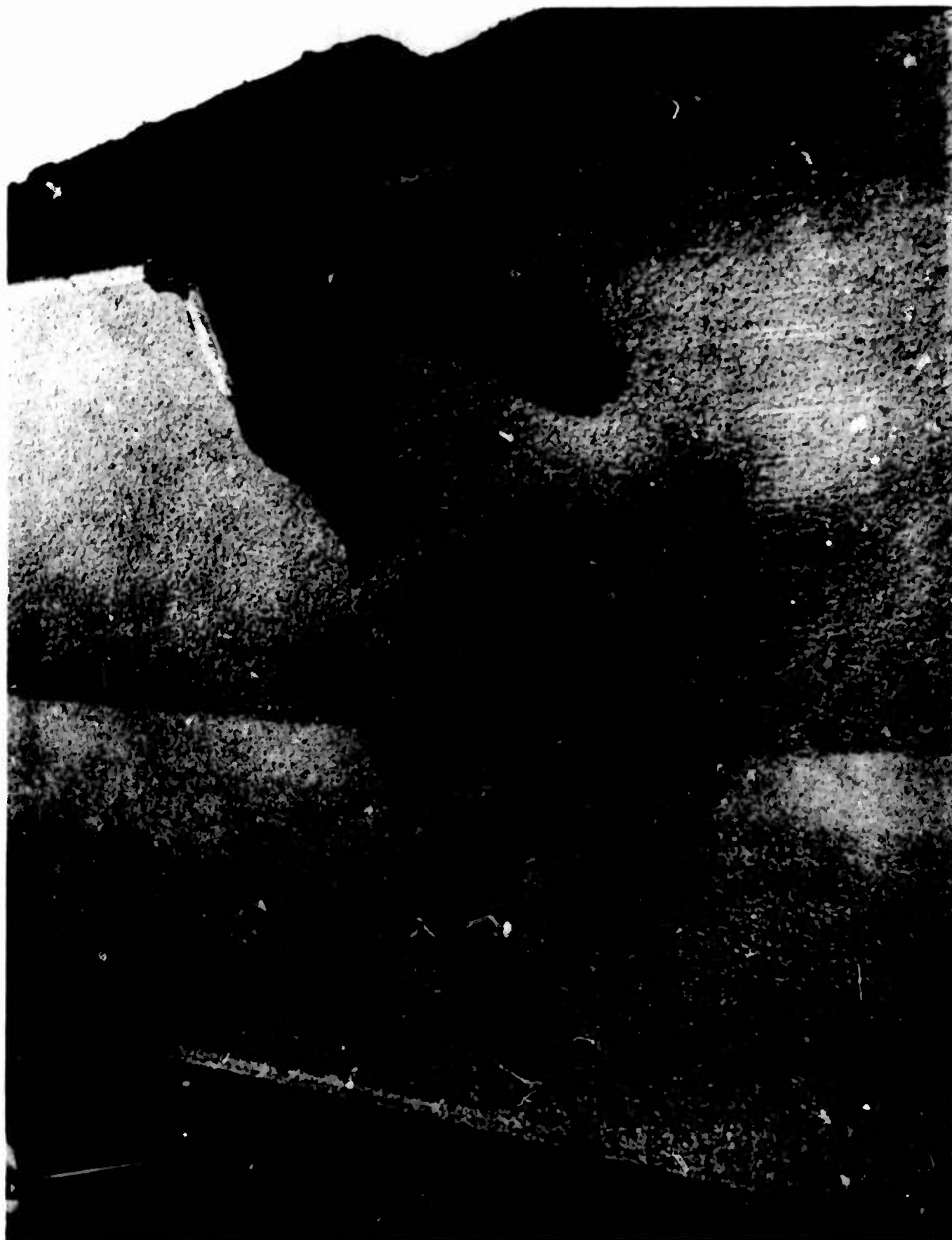


Figure 195. Fifth Avenue Chrysler Center
(Closeup of fracture in prestressed T-roof beam)



Figure 196. Fifth Avenue Chrysler Center (Fracture of concrete and two prestressing cables of another roof beam where it fell on a car)

PRESTRESSED CONCRETE BEAM



Figure 197. Fifth Avenue Chrysler Center (Pull out failure of a beam/column connection in showroom)

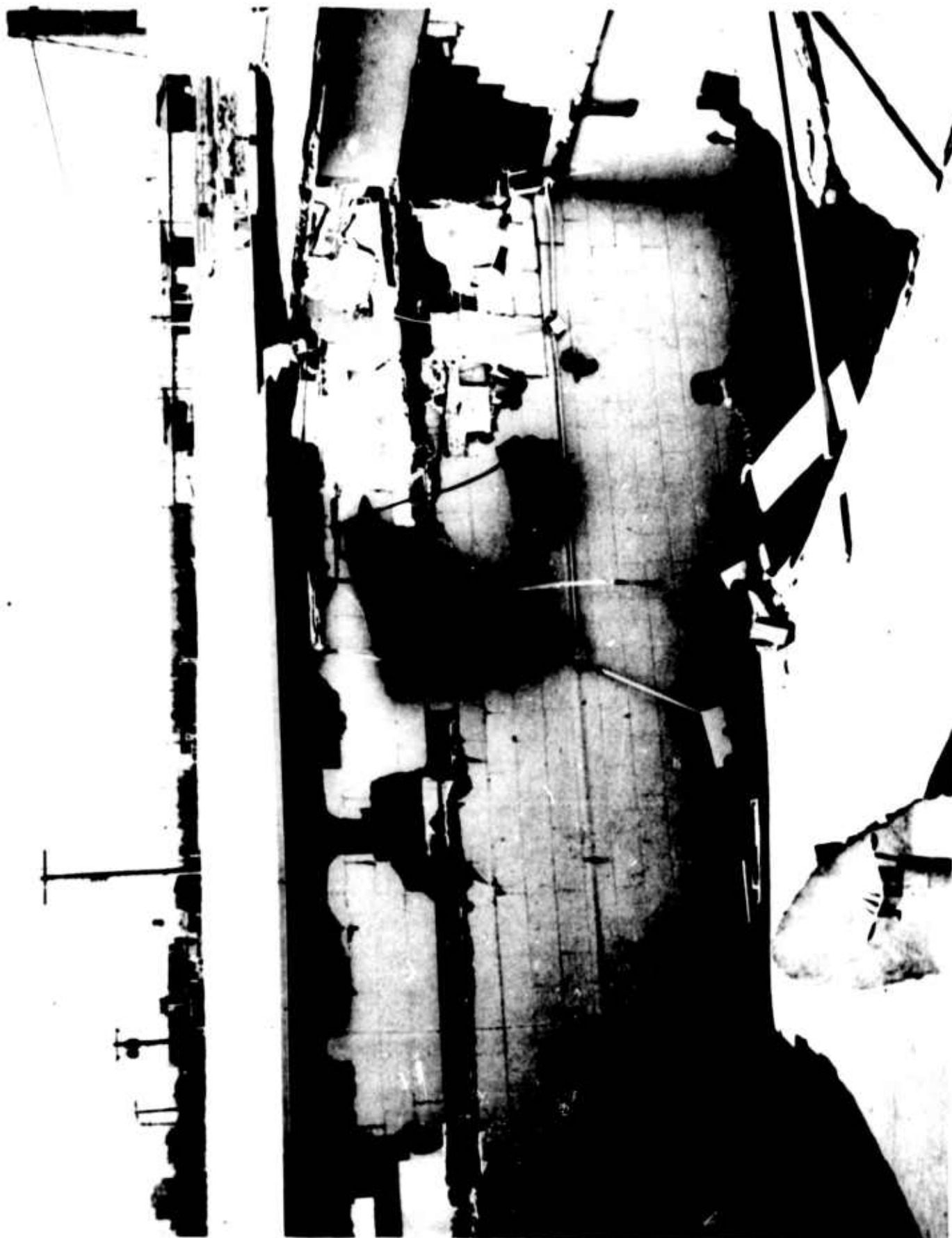


Figure 198. Fifth Avenue Chrysler Center (Damage to masonry walls caused by lateral pounding of prestressed T-roof beams)



Figure 199. Fifth Avenue Chrysler Center (Closeup of end connection of prestressed T-roof beam)



Figure 200. Fifth Avenue Chrysler Center (Damage to the structure progressed back to an interior masonry wall which provided sufficient rigidity to hold a roof beam in place and prevent further damage to those beyond)



Figure 201. Fifth Avenue Chrysler Center (Remedial measures being taken to strengthen the standing portion of the structure)

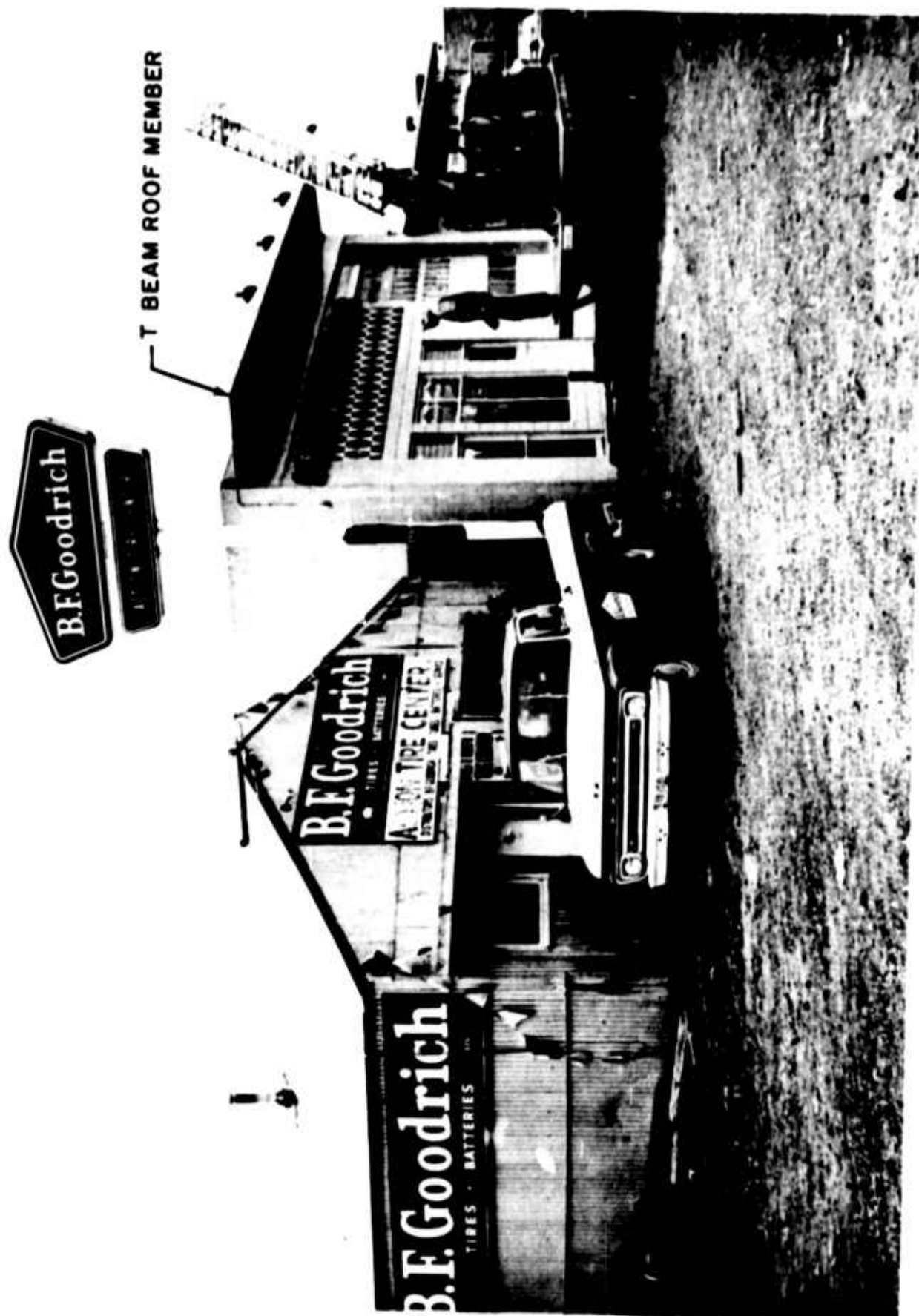


Figure 202. Action Tire Center (Undamaged building using a prestressed T-roof system a few blocks west of Fifth Avenue Chrysler Center)

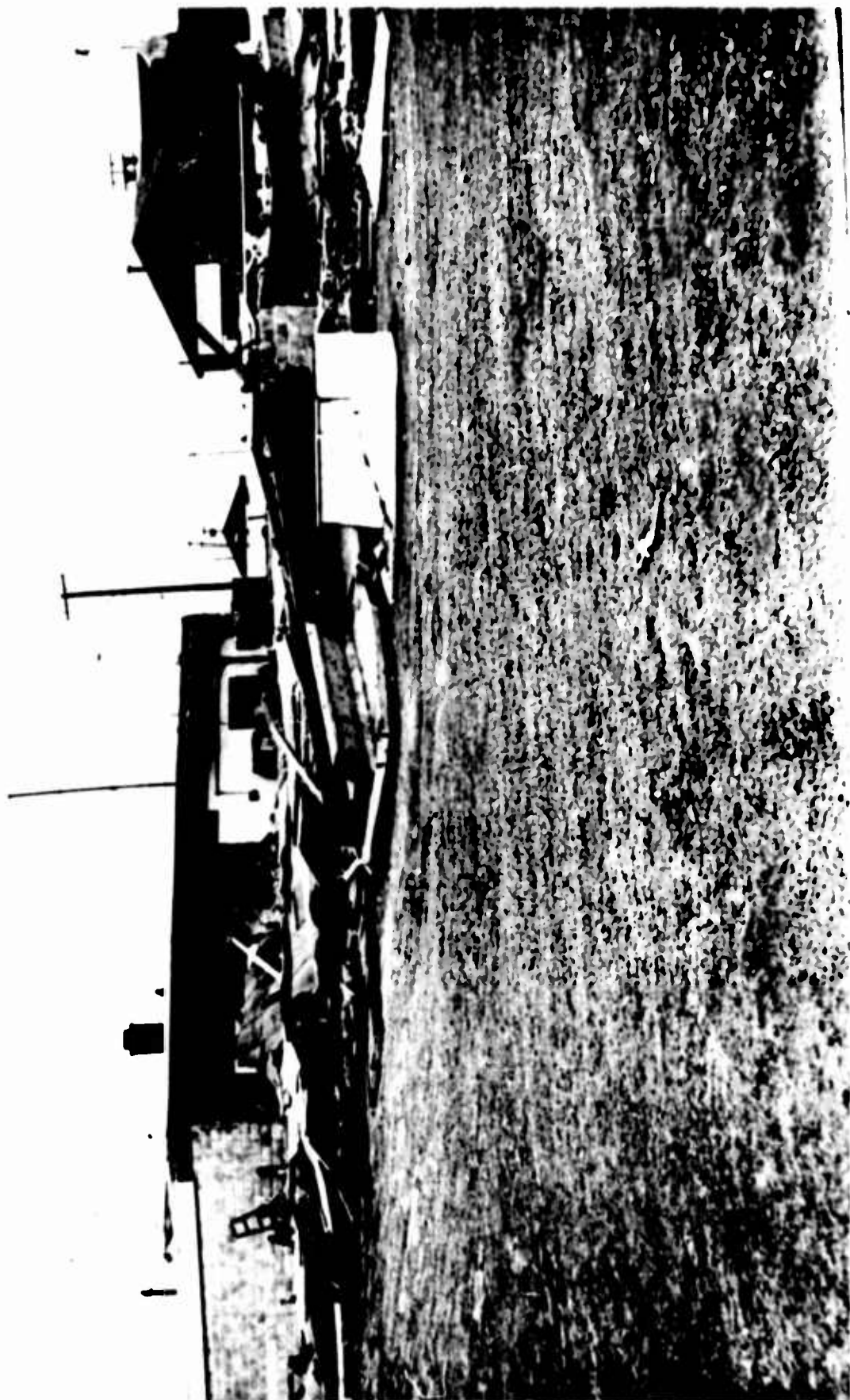


Figure 203. Gay Airways Hangar (Collapsed portion of structure)



Figure 204. Gay Airways Hangar (End connection for one of the prestressed T-roof beams)



Figure 205. Gay Airways Hangar (Fractured pilaster in the fallen east wall of the hangar)



Figure 206. Gay Airways Hangar (Closeup of fractured pilaster rebar overlap)



Figure 207. Western Radio and Telephone Building (Remains of structure)

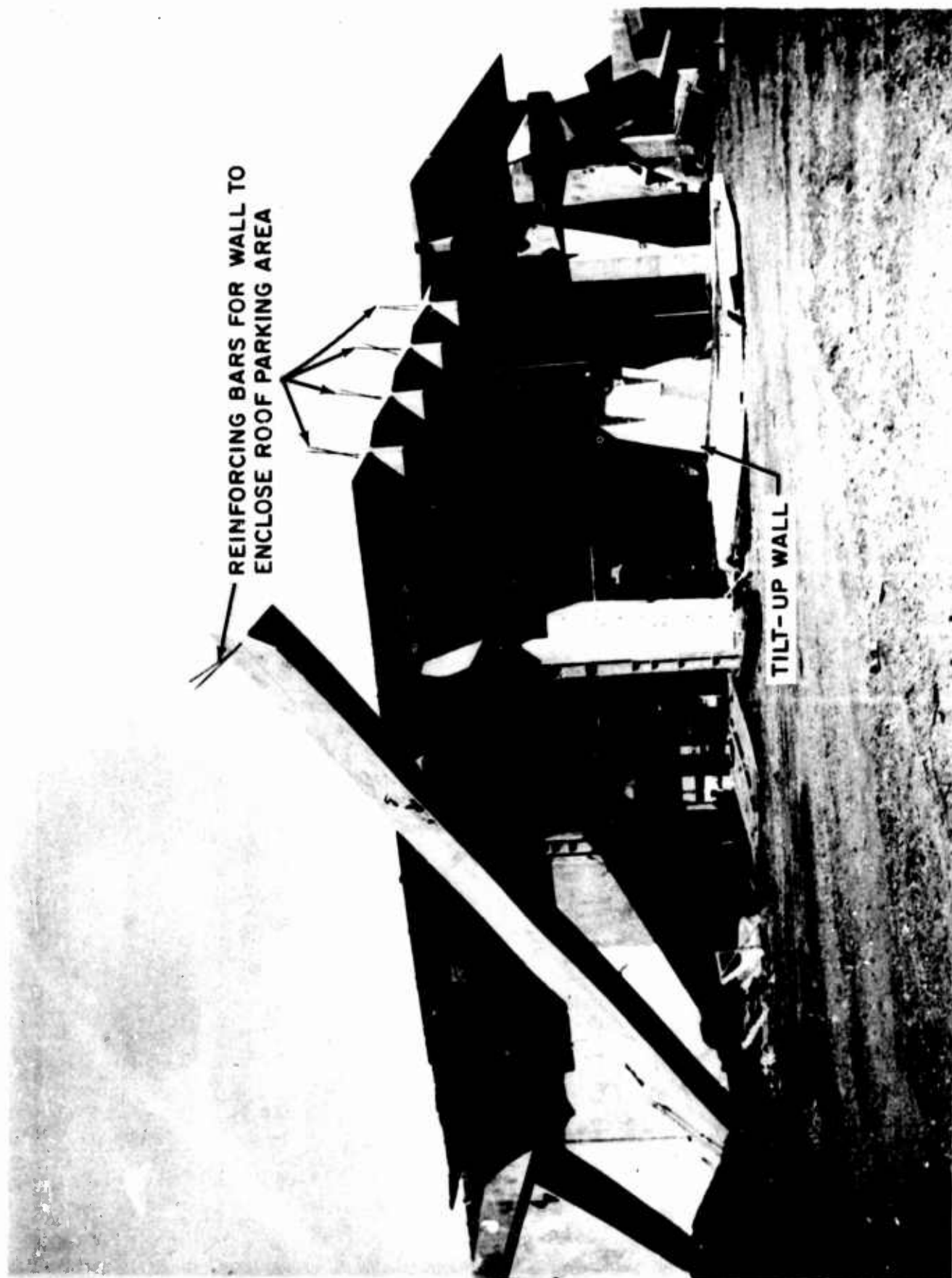


Figure 208. Alaska Sales and Service Building (Southwest corner of the unfinished structure showing fallen prestressed T-roof beams and tilt-up sandwich-wall panels)



Figure 209. Alaska Sales and Service Building
(Crushing of webs of prestressed T-roof beams resting on neoprene pads)



Figure 210. Alaska Sales and Service Building
(Spalling at the base of a heavy T-column along the north side of the structure)



Figure 211. Elmendorf AFB Aircraft Maintenance Hangar (Roof framing in the hangar)

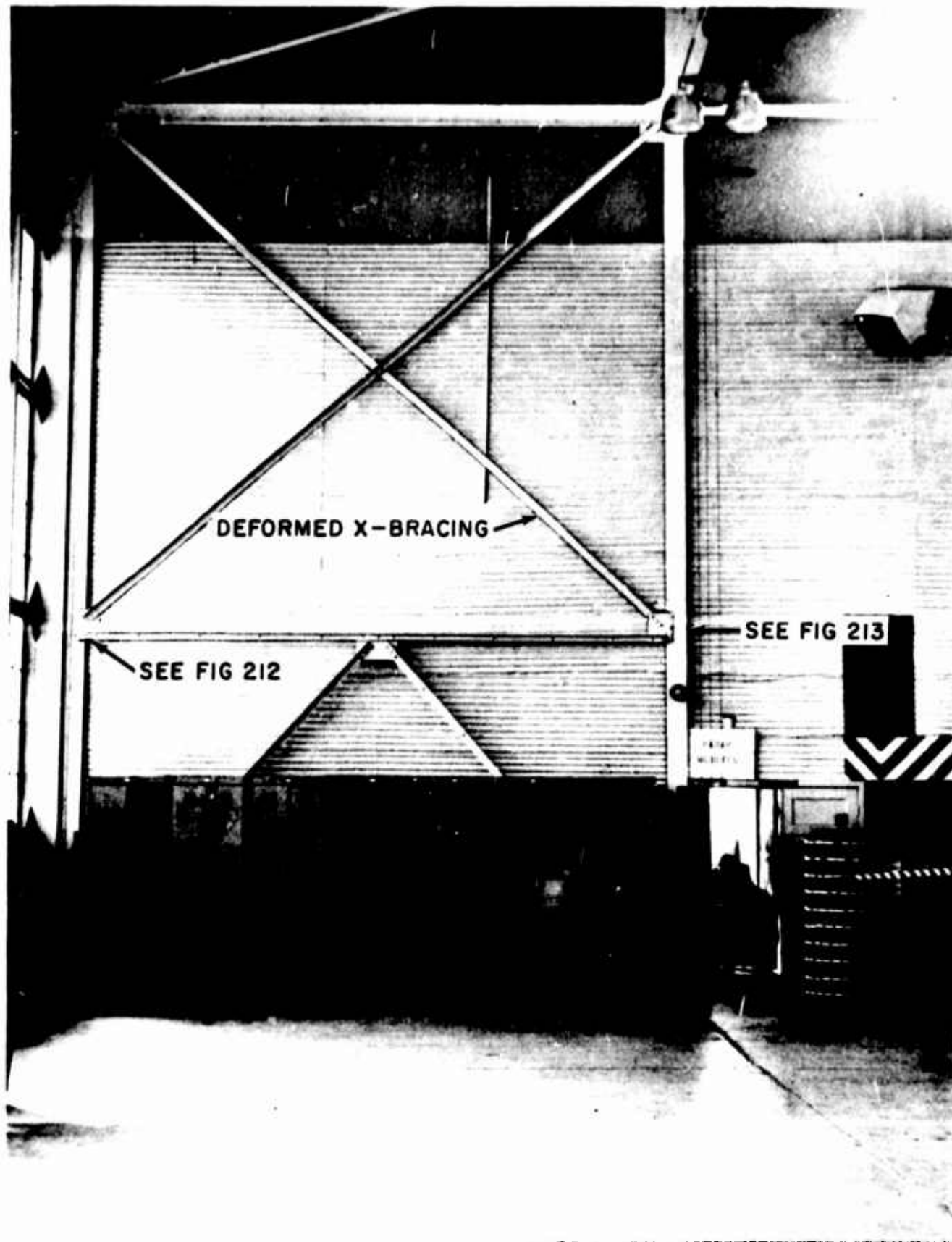


Figure 212. Elmendorf AFB Aircraft Maintenance Hangar
(Slightly bent crossbracing caused by failure of bolted connection at middle left)



Figure 213. Elmendorf AFB Aircraft Maintenance Hangar
(Failed crossbracing connection. Note two of three bolts had been omitted)

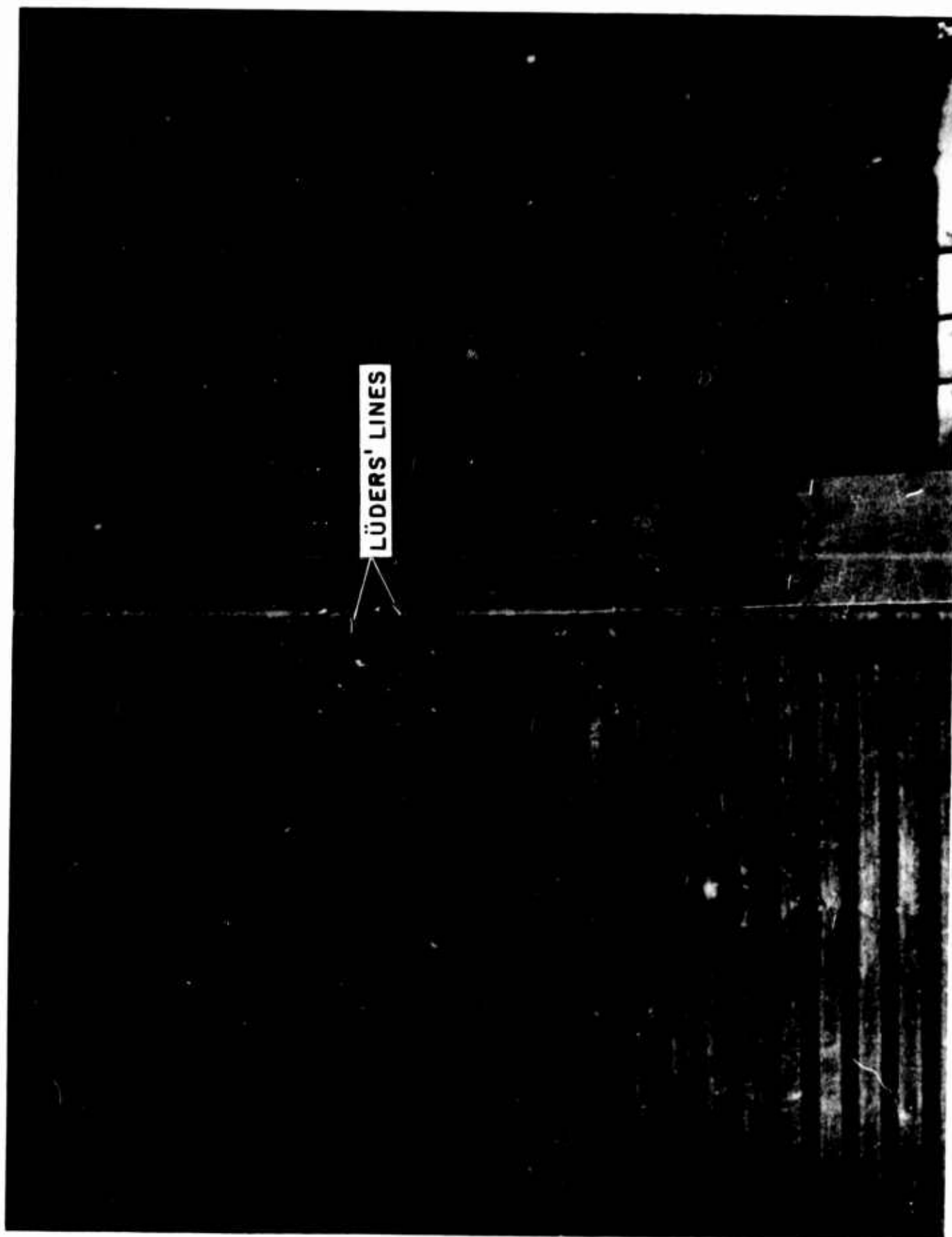


Figure 214. Elmendorf AFB Aircraft Maintenance Hangar
(Bent crossbracing connection opposite the one which failed due to lack of bolts)

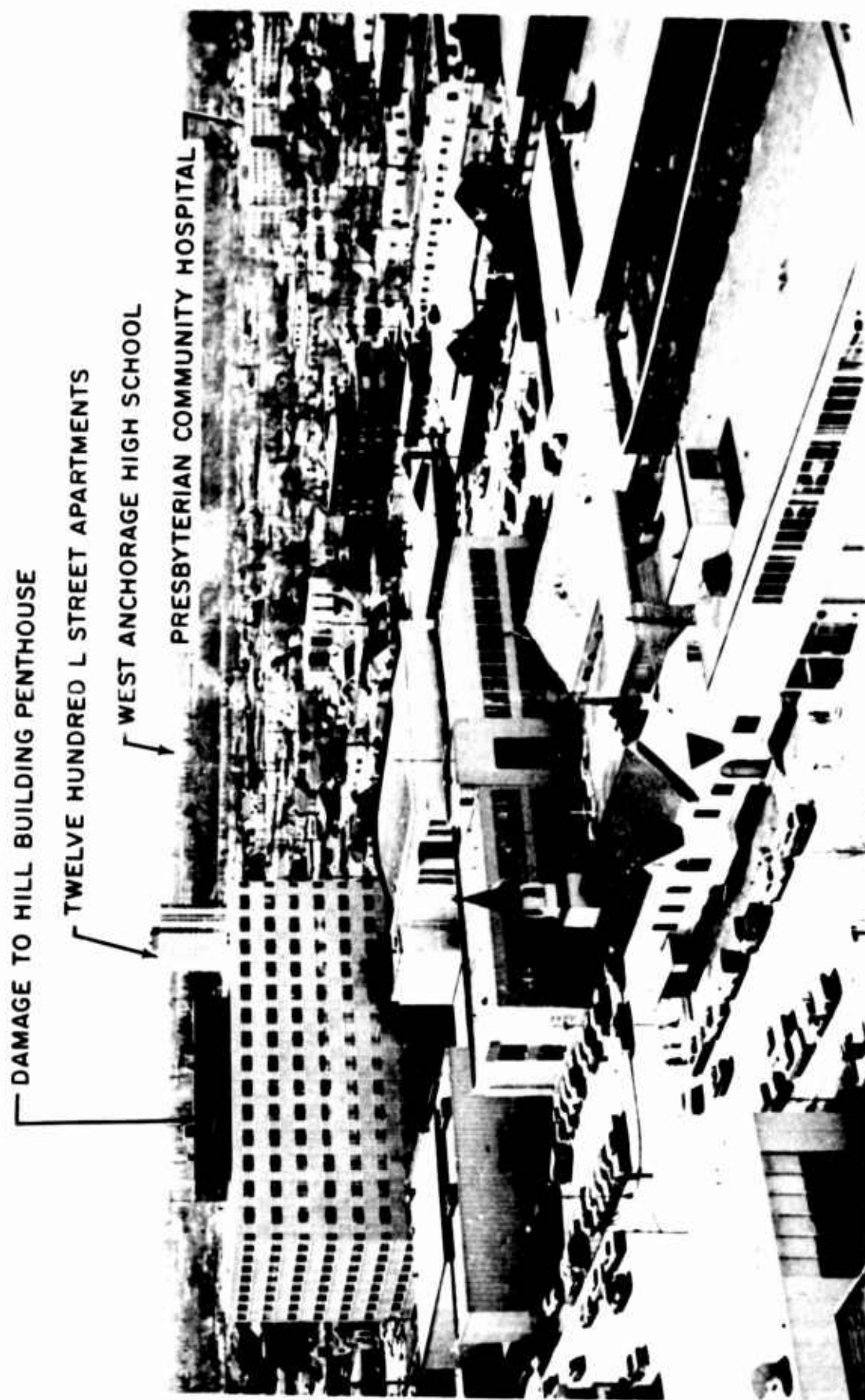


Figure 215. Hill Building (Northeast corner of building)



Figure 216. Hill Building
(West side of building under construction showing steel frame and elevator cores)



Figure 217. Hill Building (Repairs in progress inside building)



Figure 218. Cordova Building (Aerial view showing damage at southeast corner and collapsed rooftop shed)



Figure 219. Cordova Building
(Shear buckle in southeast corner column of building)

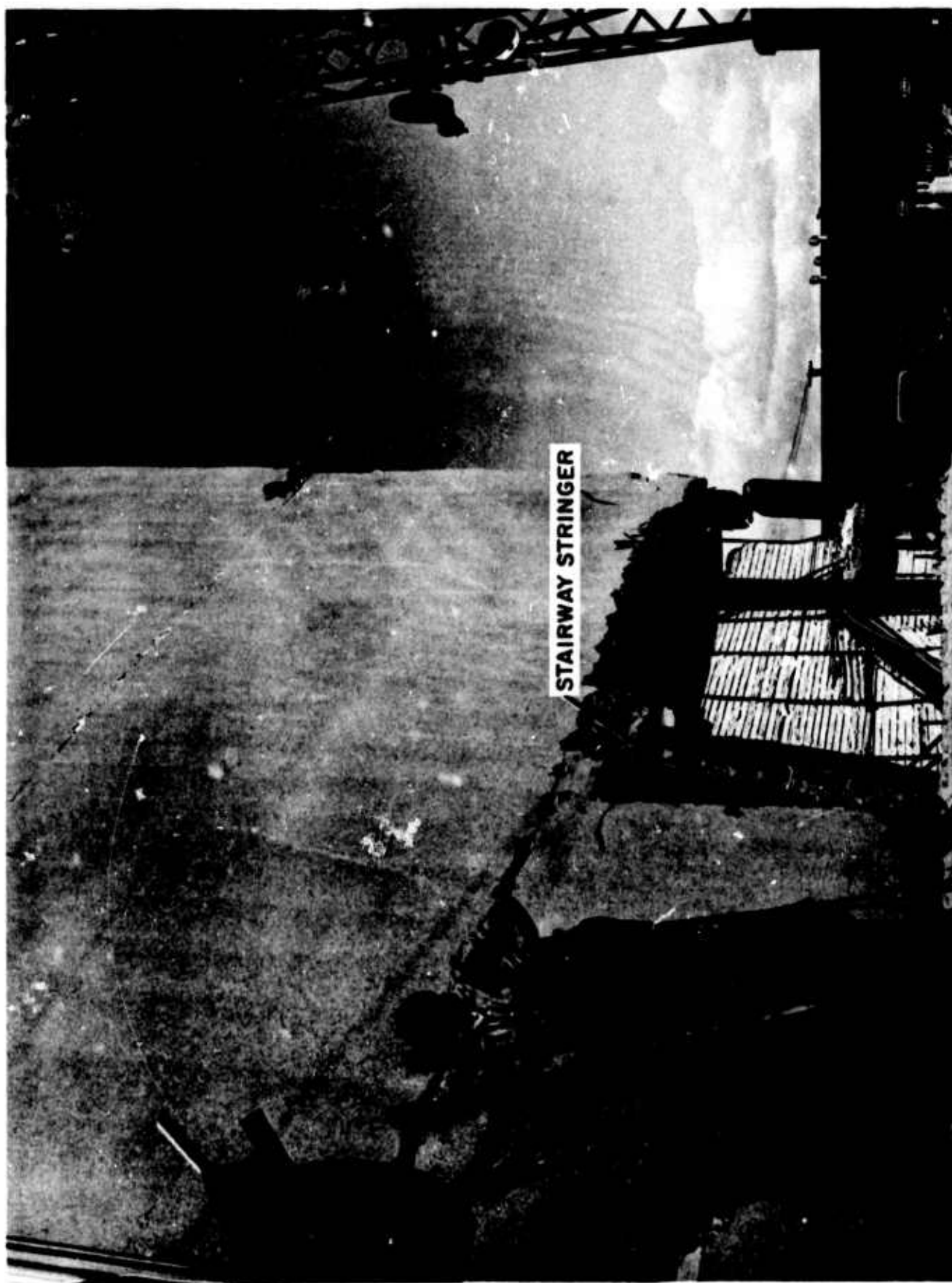


Figure 220. Cordova Building (Repair work progressed rapidly on building)

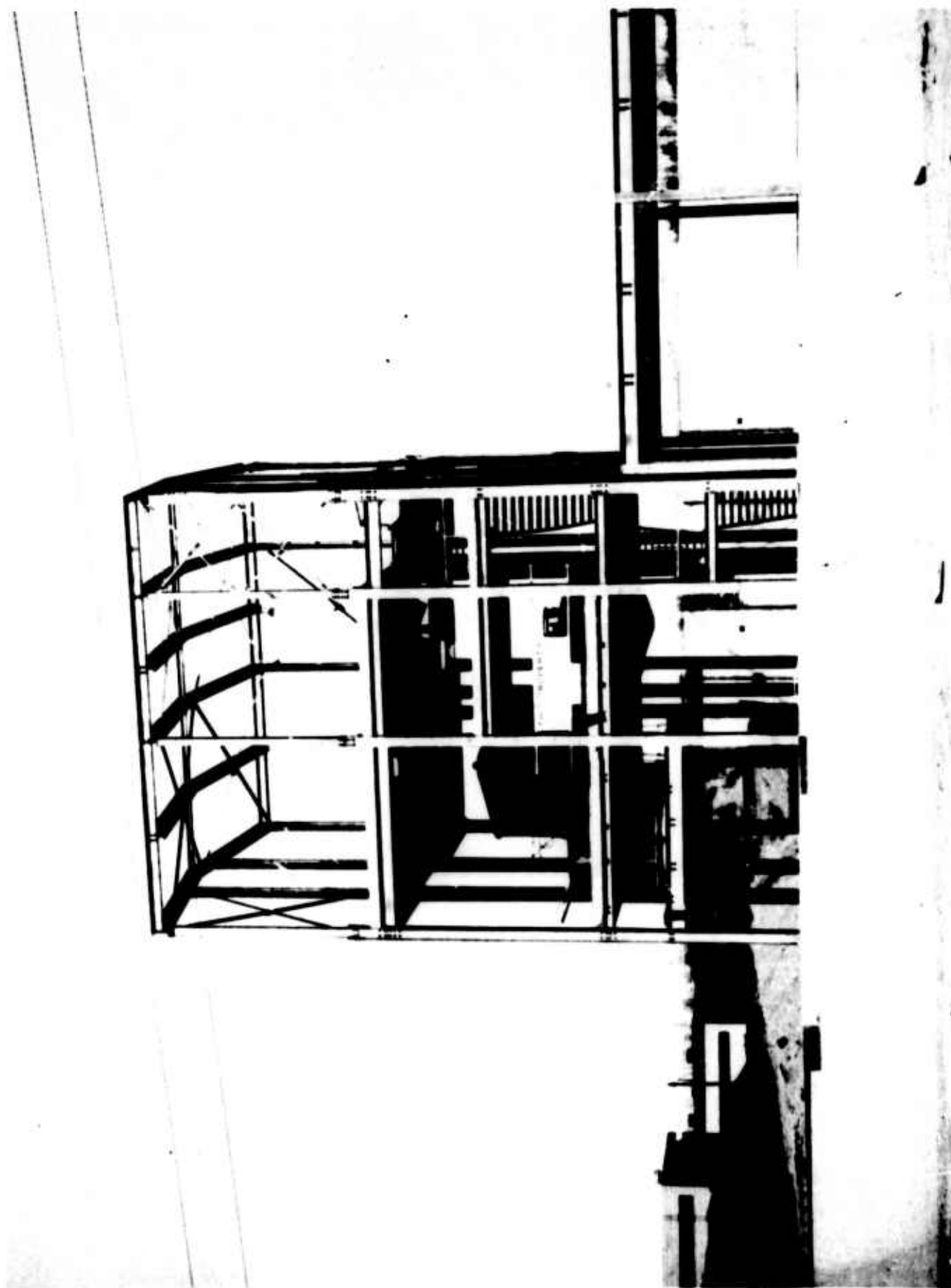


Figure 221. Alaska Brewery Company Structure (Unfinished building)



Figure 222. Alaska Brewery Company Structure (Typical undamaged bolted connection)

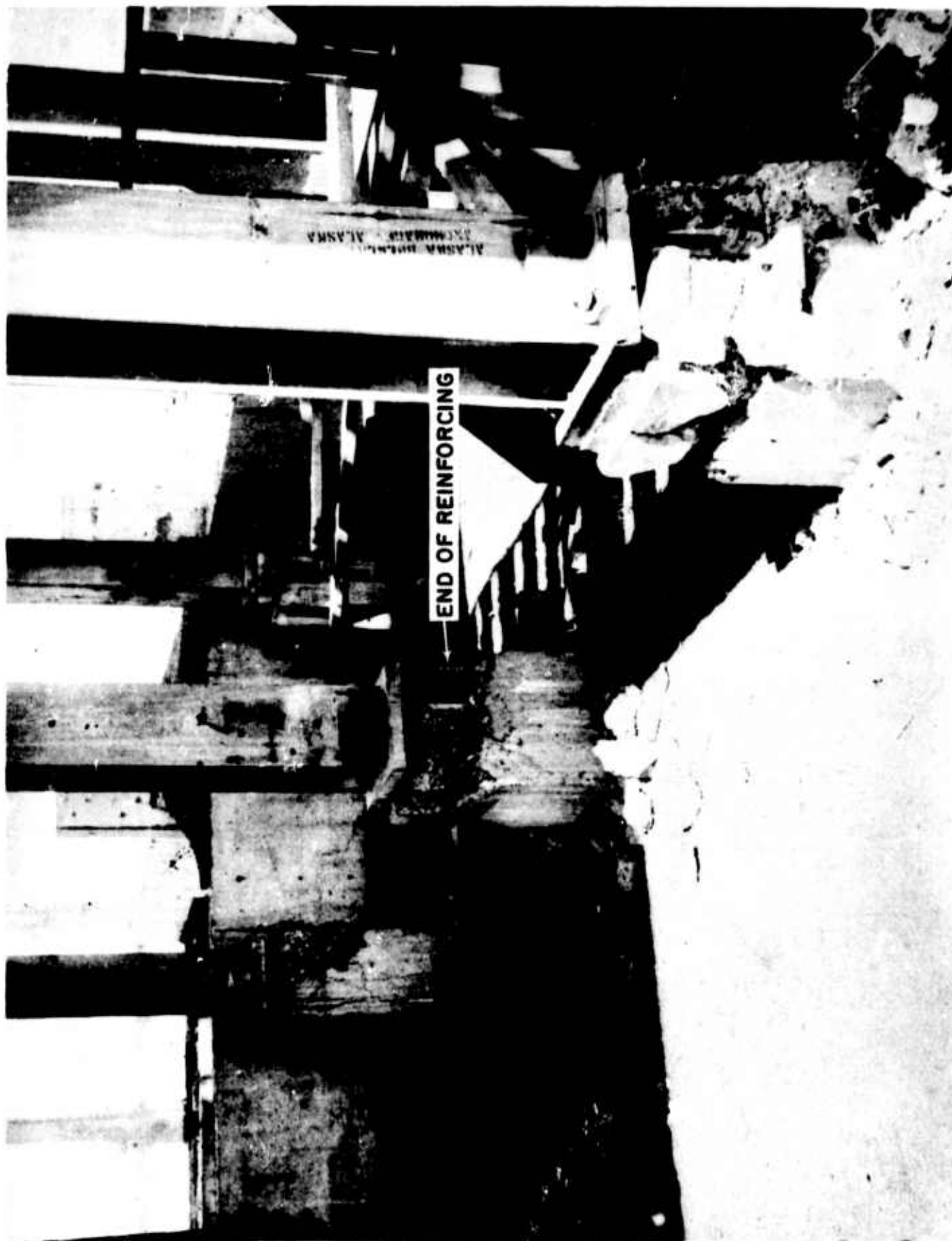


Figure 223. Alaska Brewery Company Structure
(Typical damage to interior footing due to pounding by steel columns)



Figure 224. Alaska Brewery Company Structure
(Damage to an interior footing, mainly above first horizontal tie)

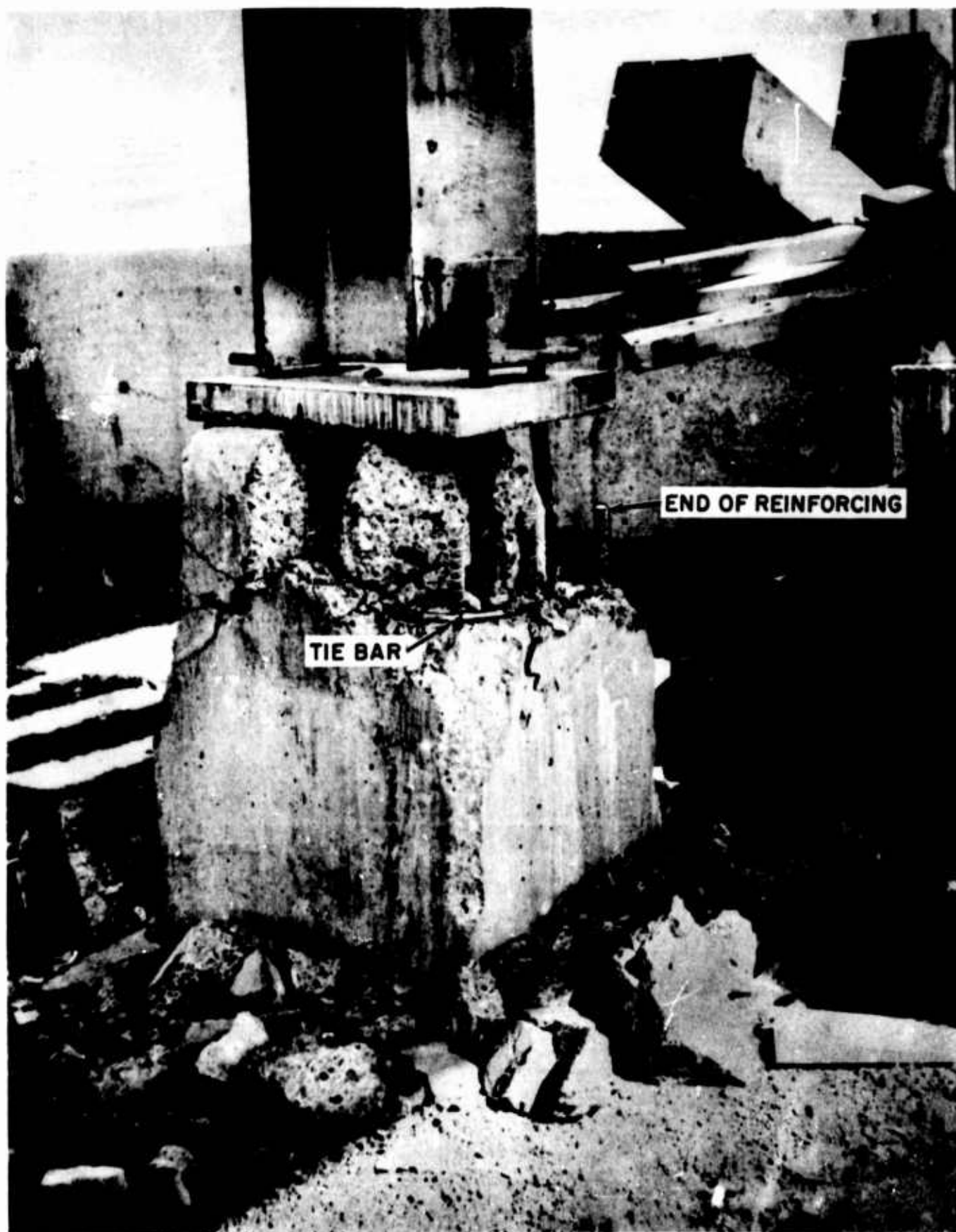


Figure 225. Alaska Brewery Company Structure
(Damage to an interior footing, mainly above first horizontal tie)



Figure 226. Alaska Brewery Company Structure
(Severe damage to an exterior footing without horizontal ties)



Figure 227. Permanente Cement Bin, Aerial View
(In upper right are the Shell Oil Company storage tanks discussed in section XII.6)

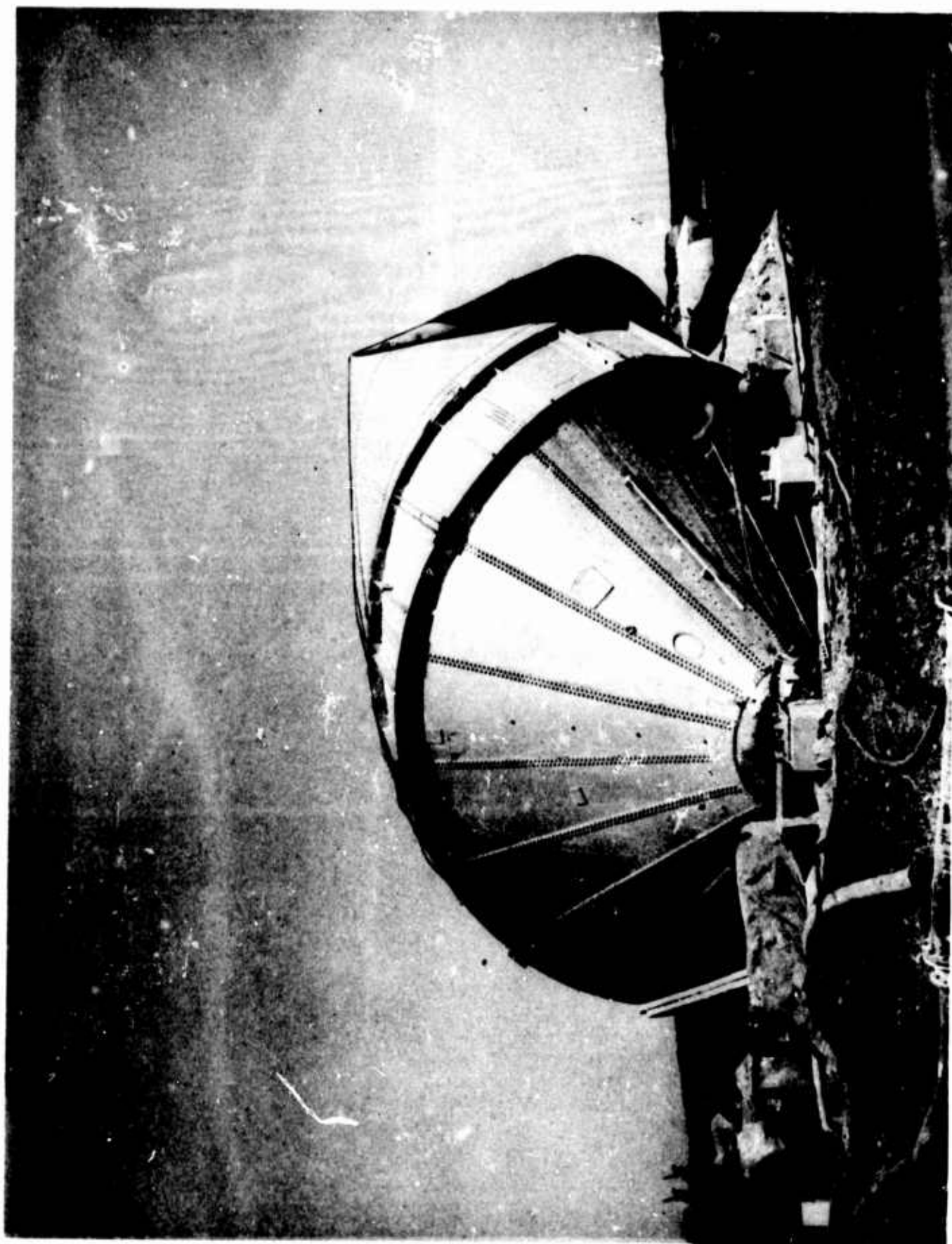


Figure 228. Permanente Cement Bin
(Bottom of fallen bin after removal of twisted supporting framework was still visible in figure 227)

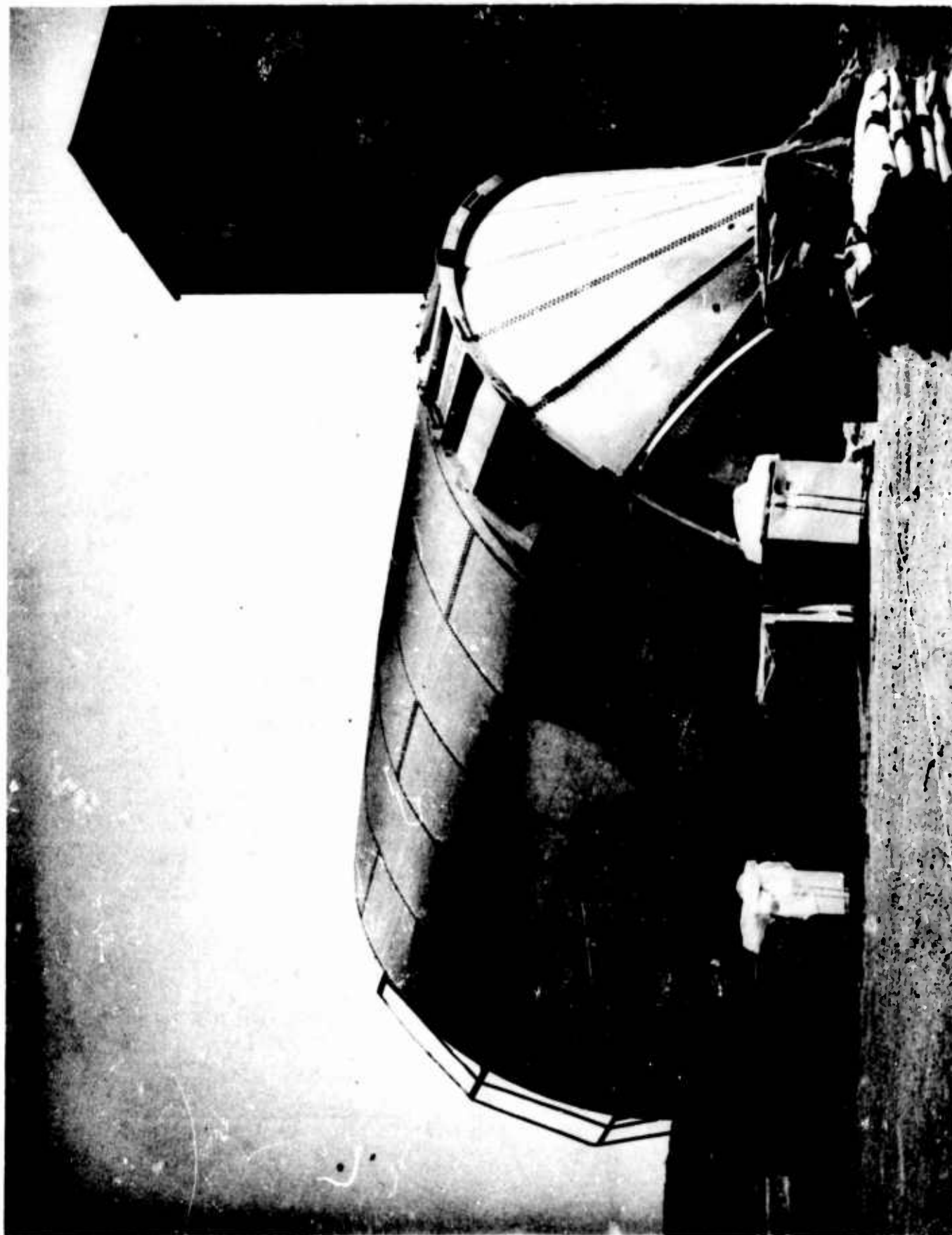


Figure 229. Permanente Cement Bin (West side of fallen bin)



Figure 230. Permanent Cement Bin (Ruptured top of fallen bin)

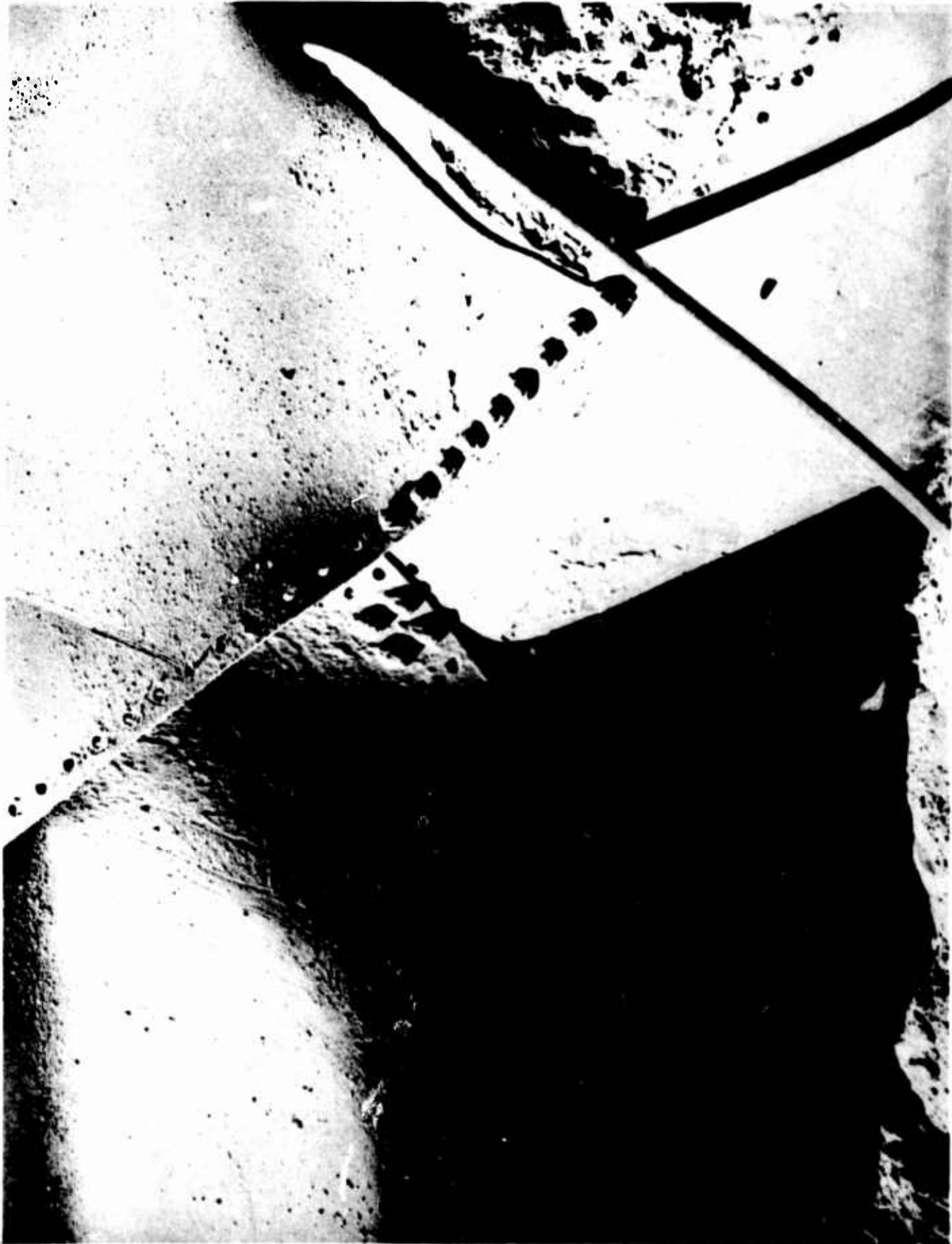


Figure 231. Permanente Cement Bin (Closeup of torn bolted seam in side of fallen bin)

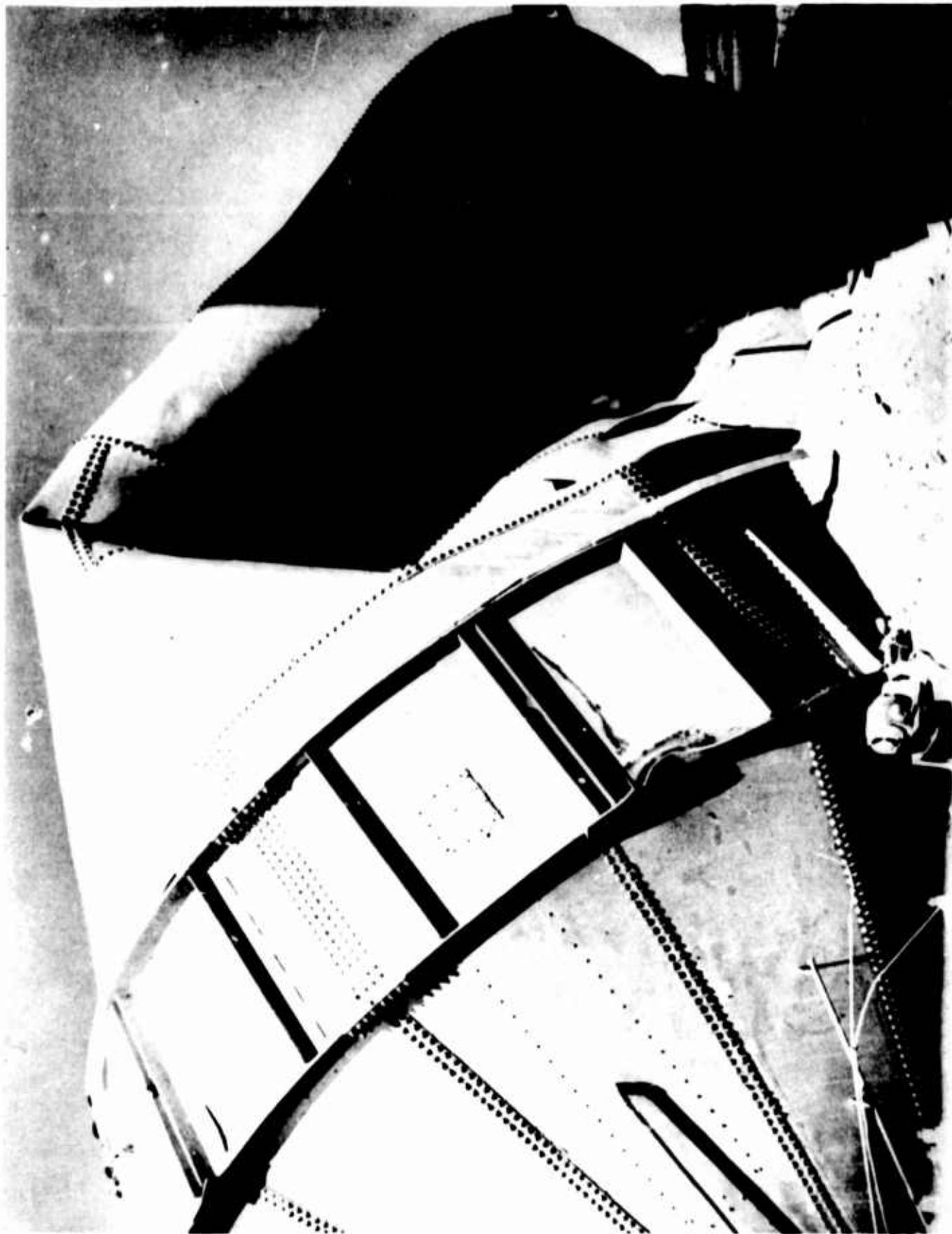


Figure 232. Permanente Cement Bin (Closeup of folded side of fallen bin)

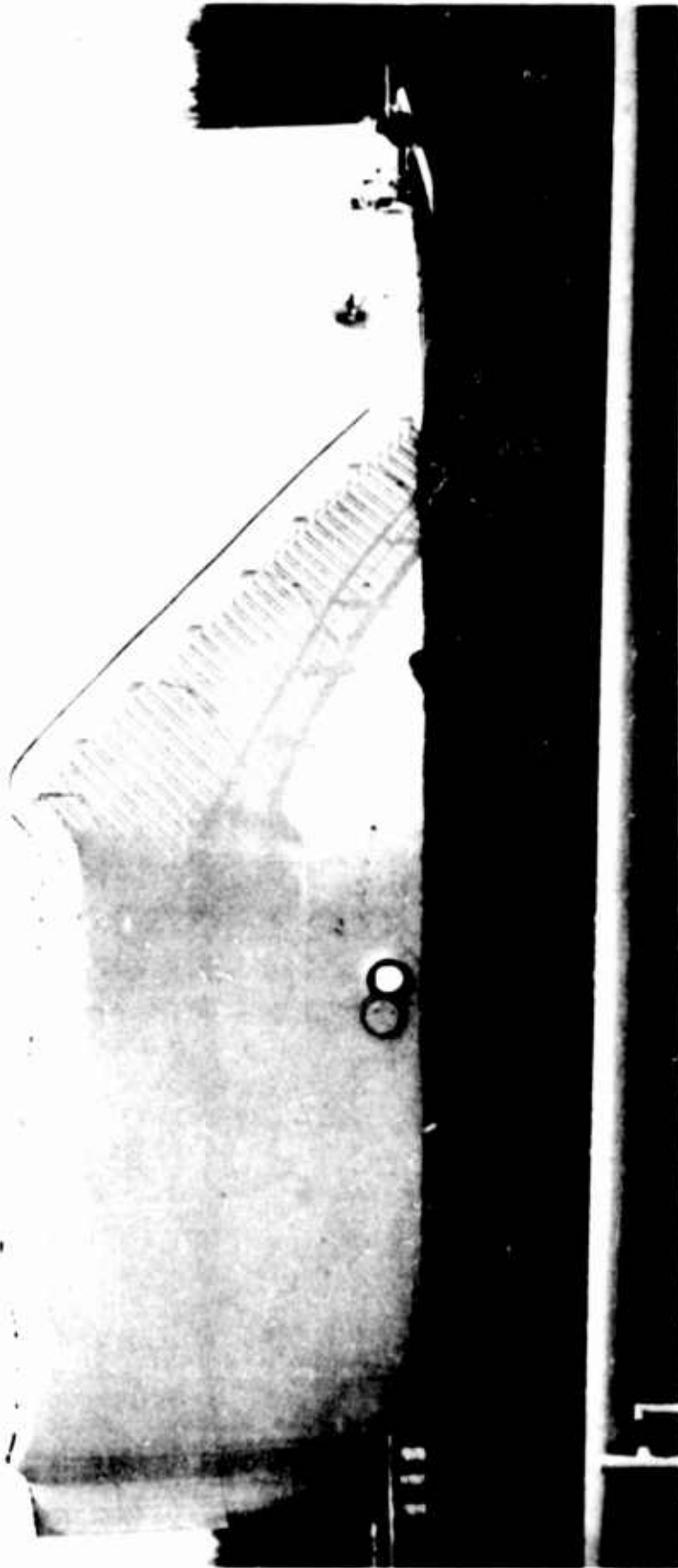


Figure 233. Shell Oil Company Waterfront Storage Tank
(West side of collapsed tank as it appeared six weeks after the earthquake)

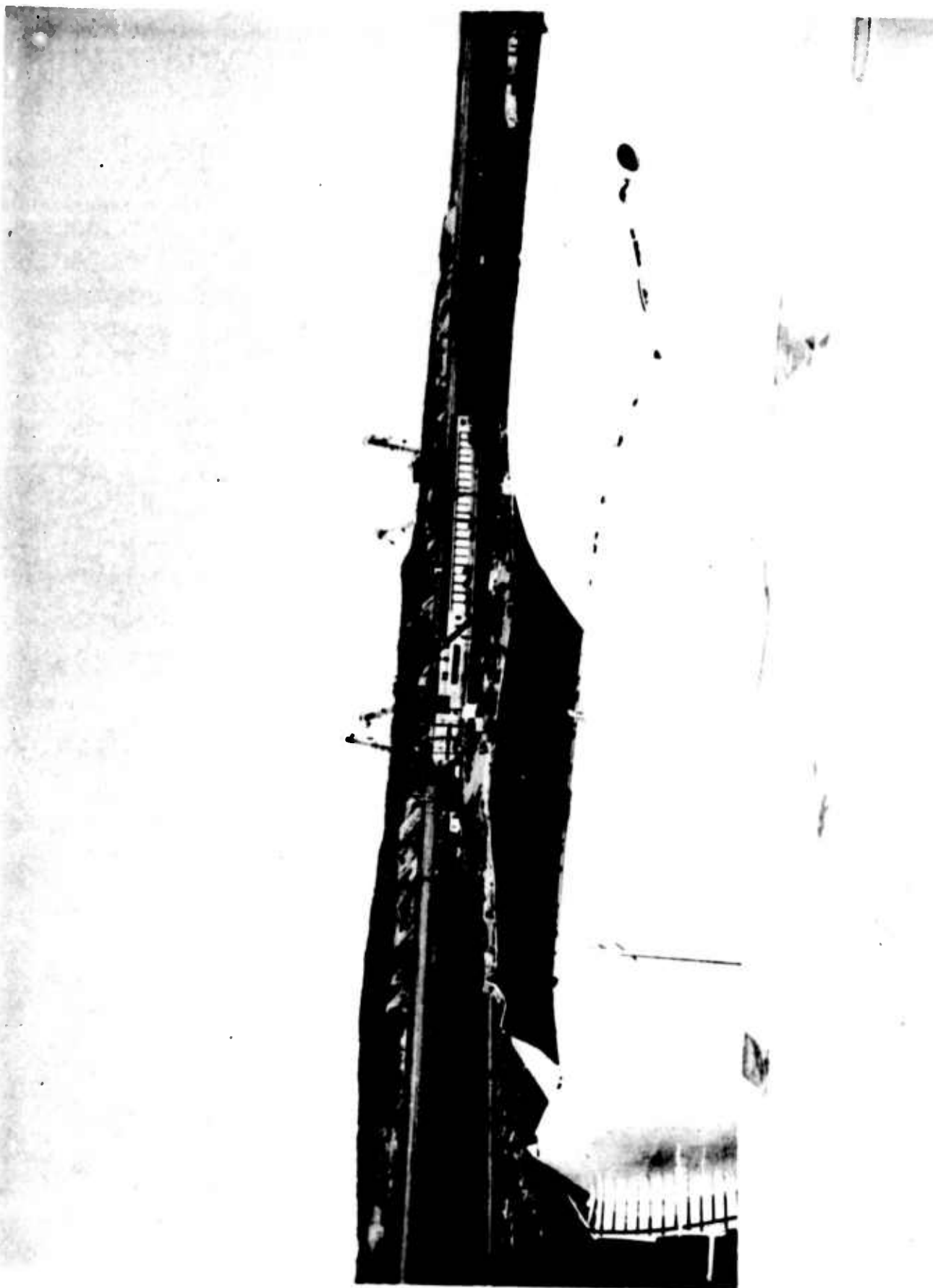


Figure 234. Shell Oil Company Waterfront Storage Tank (Top of collapsed tank)



Figure 235. Shell Oil Company Waterfront Storage Tank (Fallen roof ring beam lying on floor of tank)



Figure 236. Shell Oil Company Waterfront Storage Tank
(Closeup of failed ring beam/column connection inside collapsed tank)



Figure 237. Shell Oil Company Waterfront Storage Tank
(Closeup of failed bolted connection between radial stringer and ring beam inside collapsed tank)



Figure 238. Shell Oil Company Waterfront Storage Tank
(Collapse of internal bracing permitted top of tank to tear away from tank side)

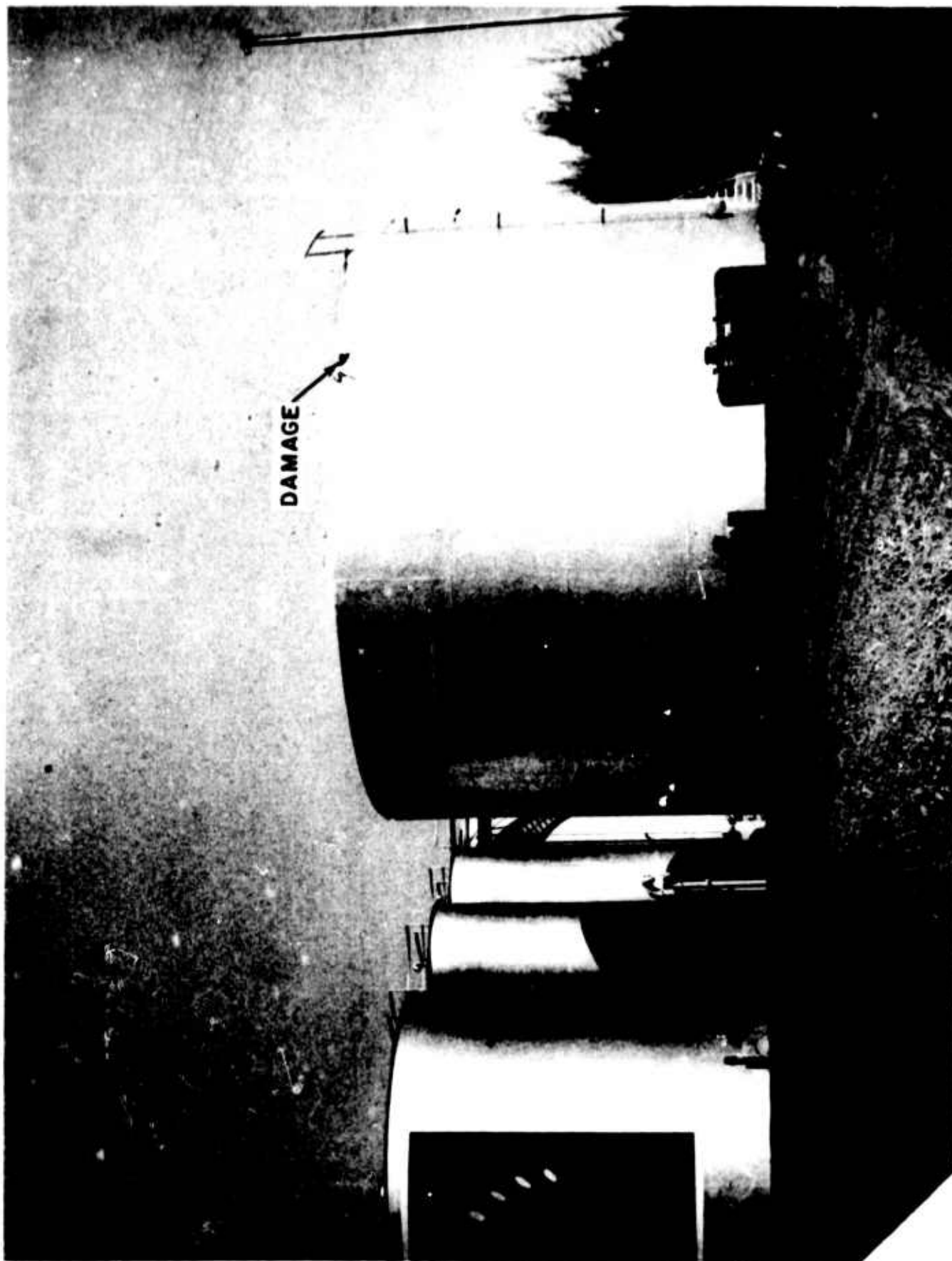


Figure 239. Shell Oil Company International Airport Storage Tank
(Most of the damage to this tank is hidden from view below the earth dike)

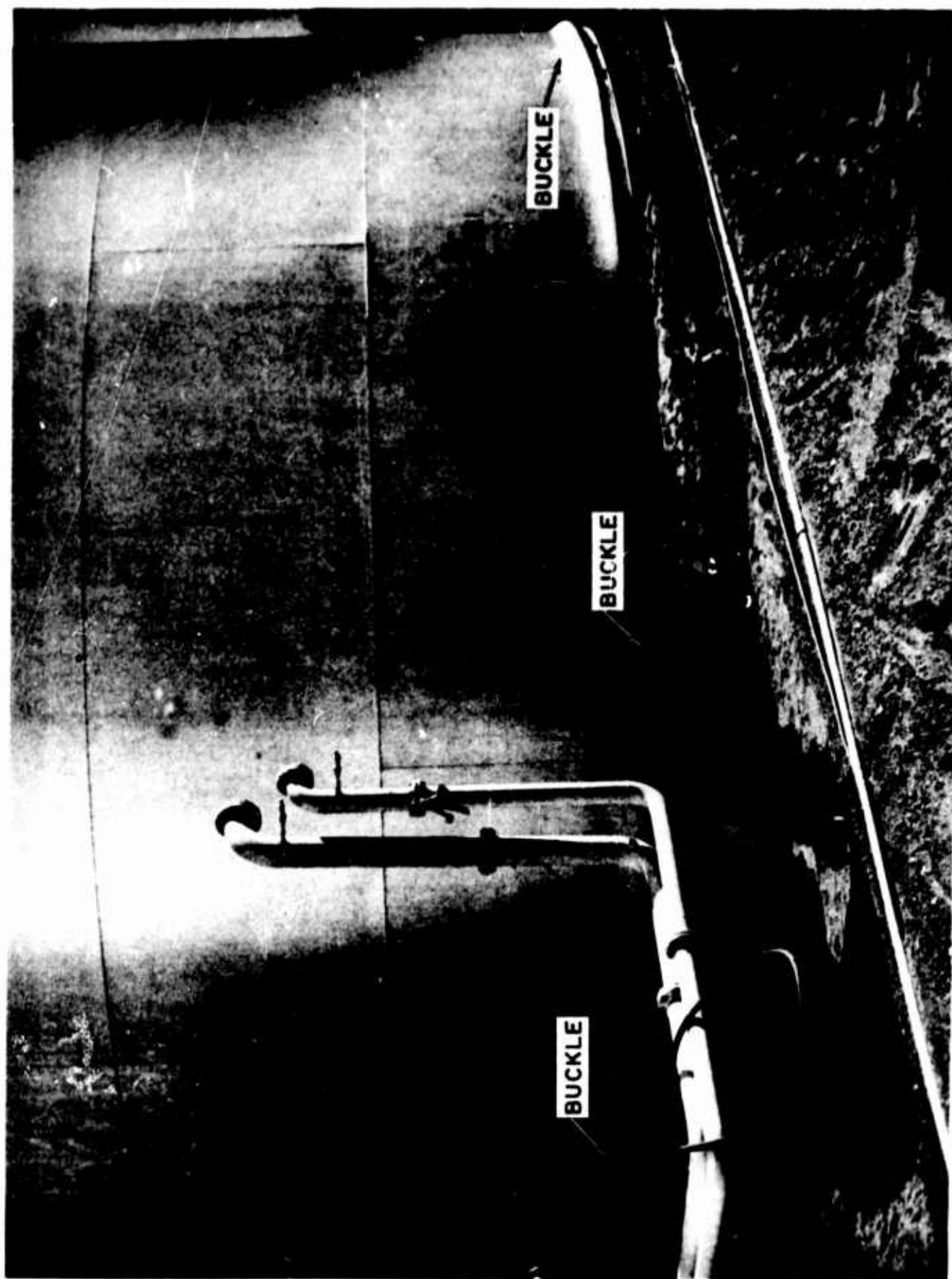


Figure 240. Shell Oil Company International Airport Storage Tank (Single buckle at base of tank)

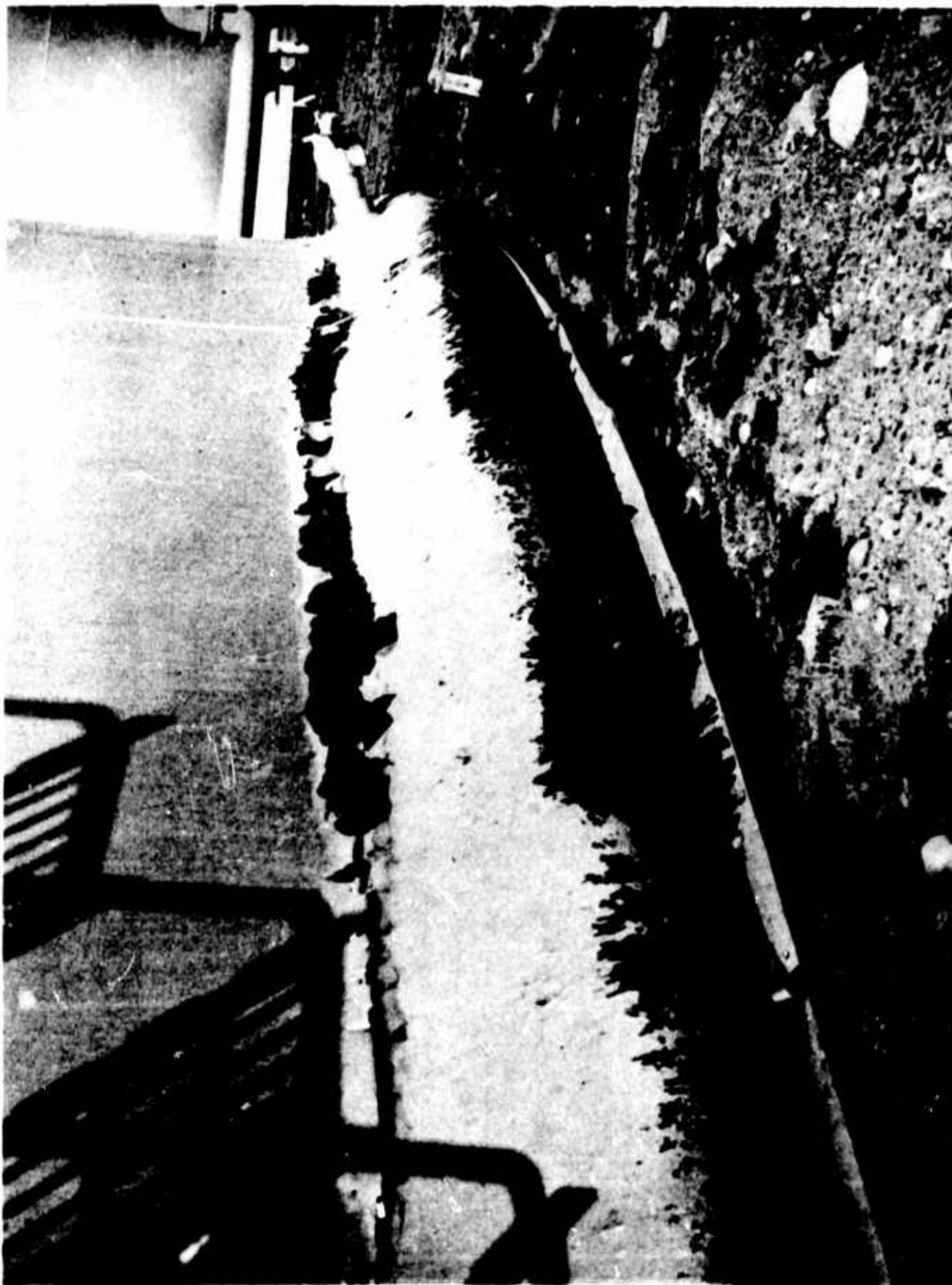


Figure 241. Shell Oil Company International Airport Storage Tank (Closeup of buckle at base of tank)



Figure 242. Shell Oil Company International Airport Storage Tank (Closeup of buckle at base of tank)



Figure 243. Alaska Aggregate Corporation Dock (Aerial view showing fallen crane and cement bin)

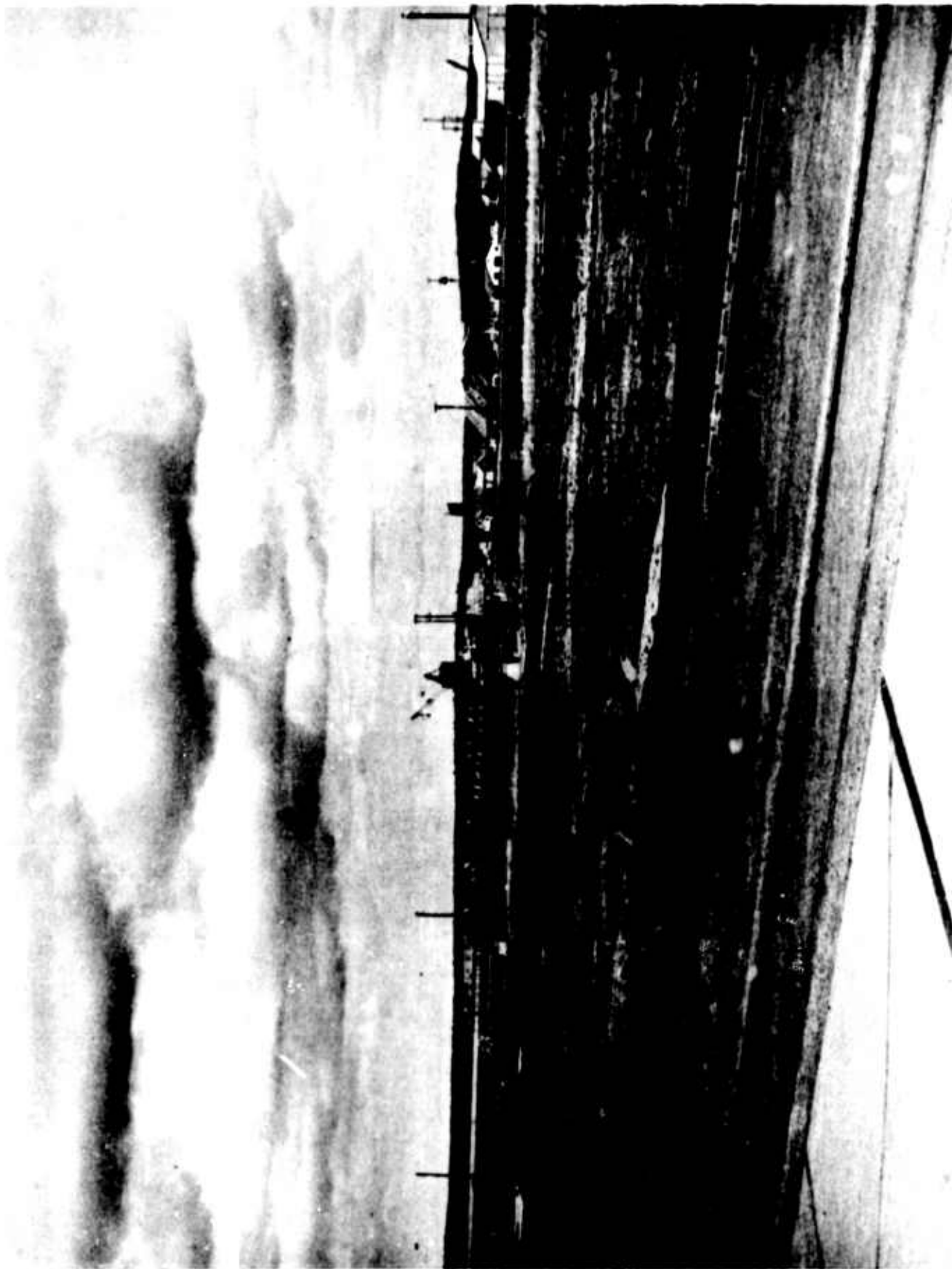


Figure 244. Alaska Railroad Ship Creek Inlet Bridge (Steel truss)



Figure 245. Alaska Railroad Ship Creek Inlet Bridge
(Neither the bridge nor any of the abutments suffered noticeable earthquake damage)



Figure 246. Alaska Railroad Ship Creek Inlet Bridge
(Tracks appear to be in good condition after the earthquake)

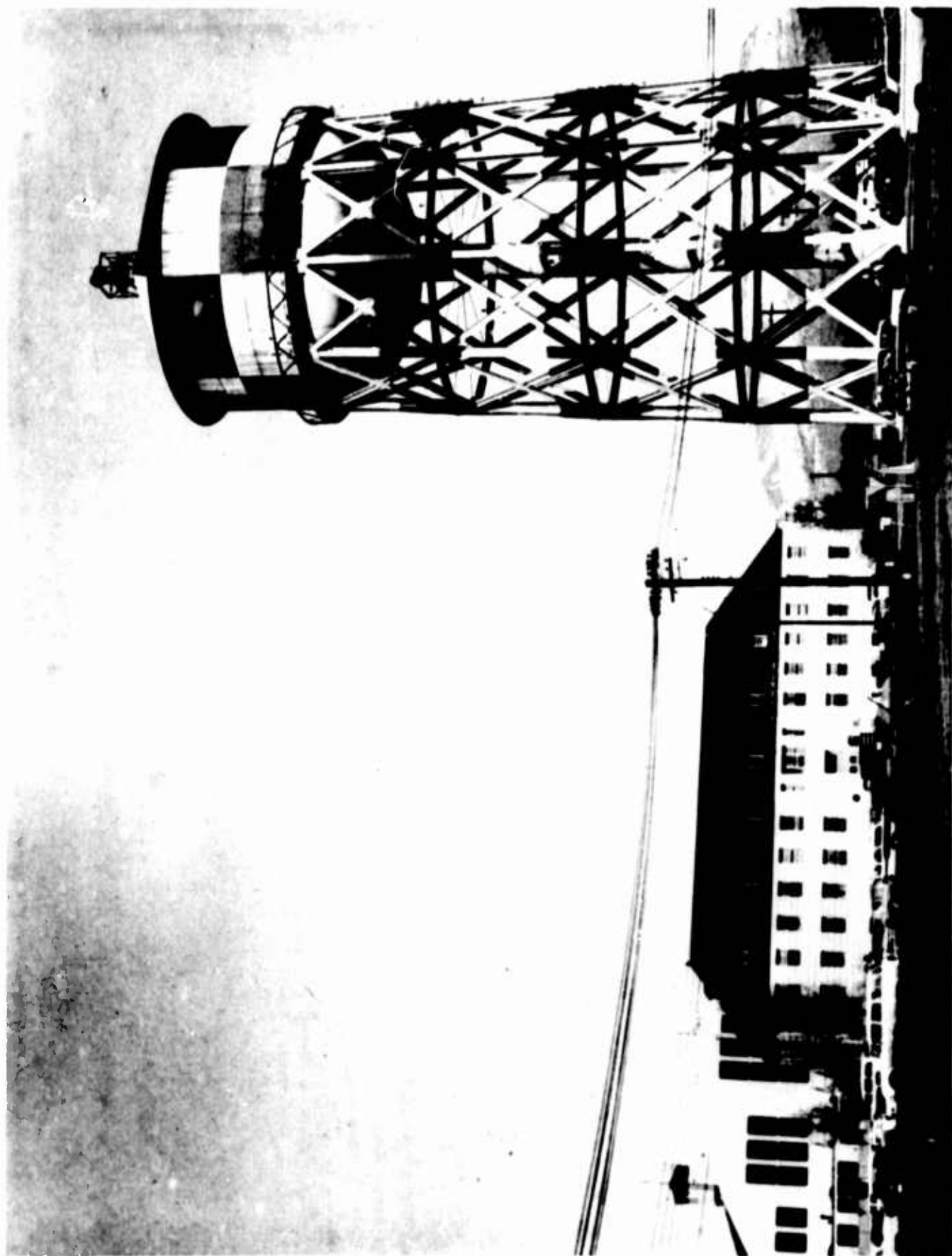


Figure 247. Elmendorf AFB Water Tower (Undamaged. Camera angle gives illusion of tipping.)

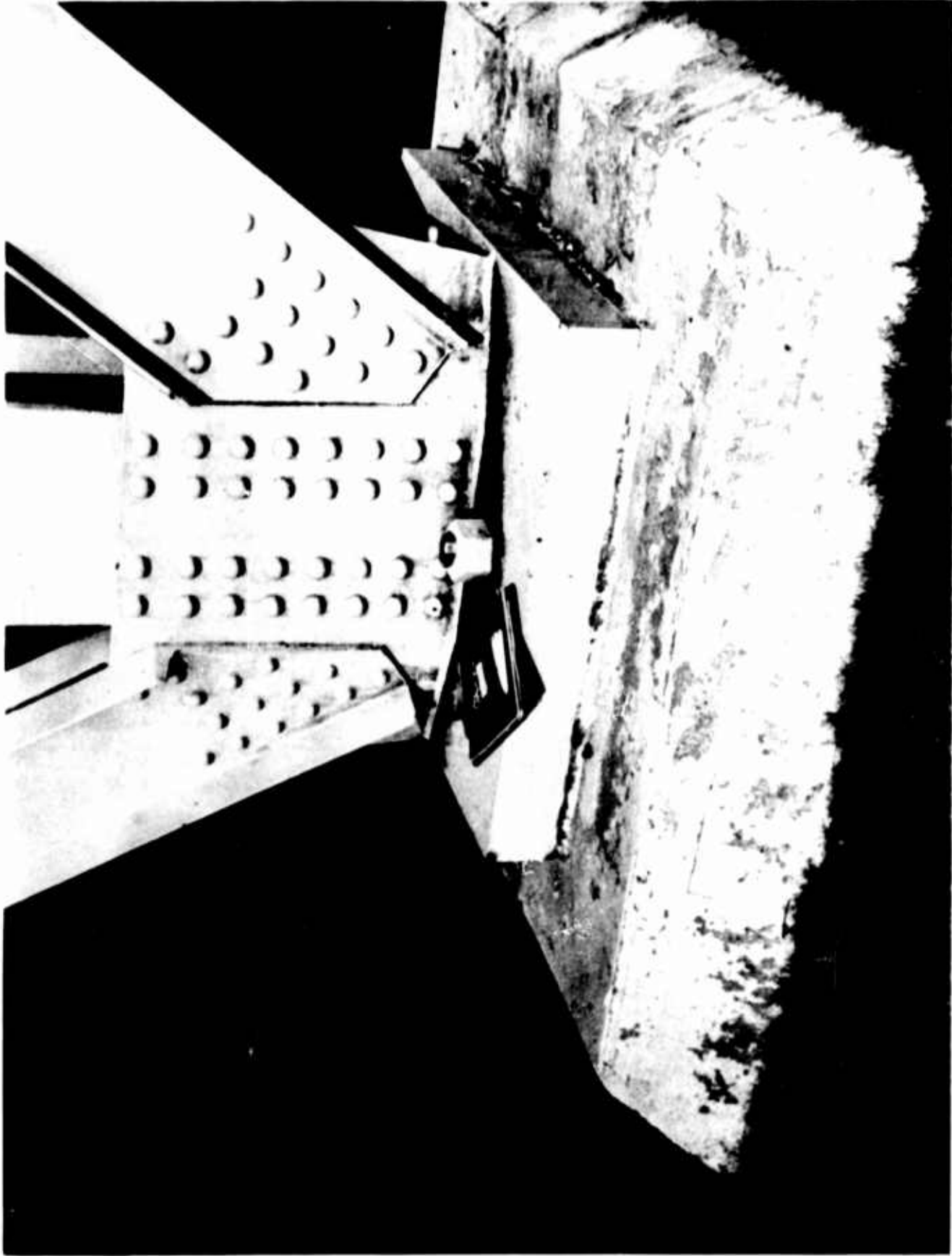


Figure 248. Elmendorf AFB Water Tower (Undamaged footing)

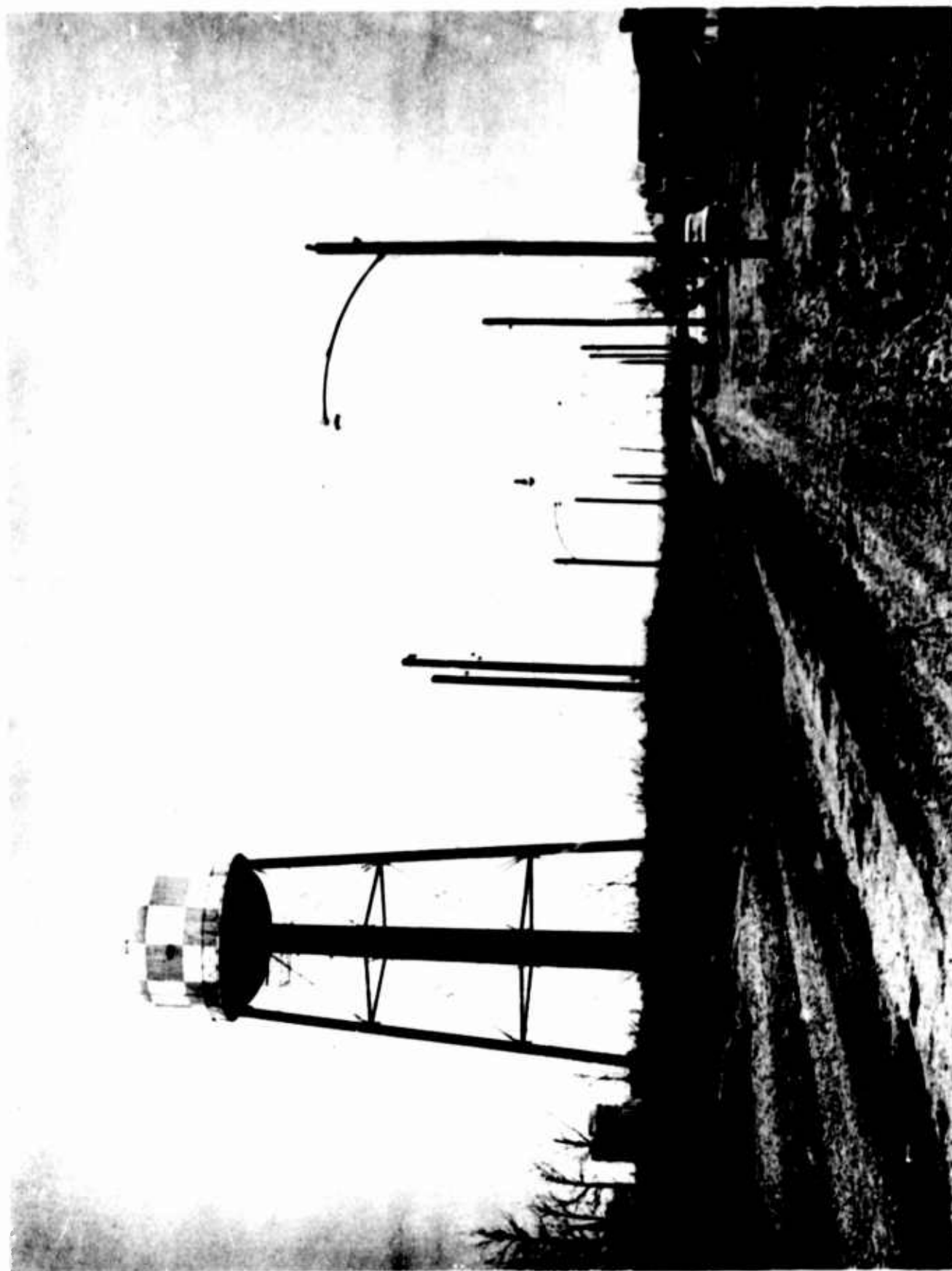


Figure 249. Government Hill Water Tower (Undamaged)



Figure 250. Alaska Native Hospital Water Tower (Forty-nine-year-old tower undamaged by the quake although it stands about one hundred feet from First Avenue slide. Tank was reported to have been empty when the quake struck.)



Figure 251. Alaska Native Hospital Water Tower
(Tie-rod turnbuckle at base of tower shows no sign of yielding)

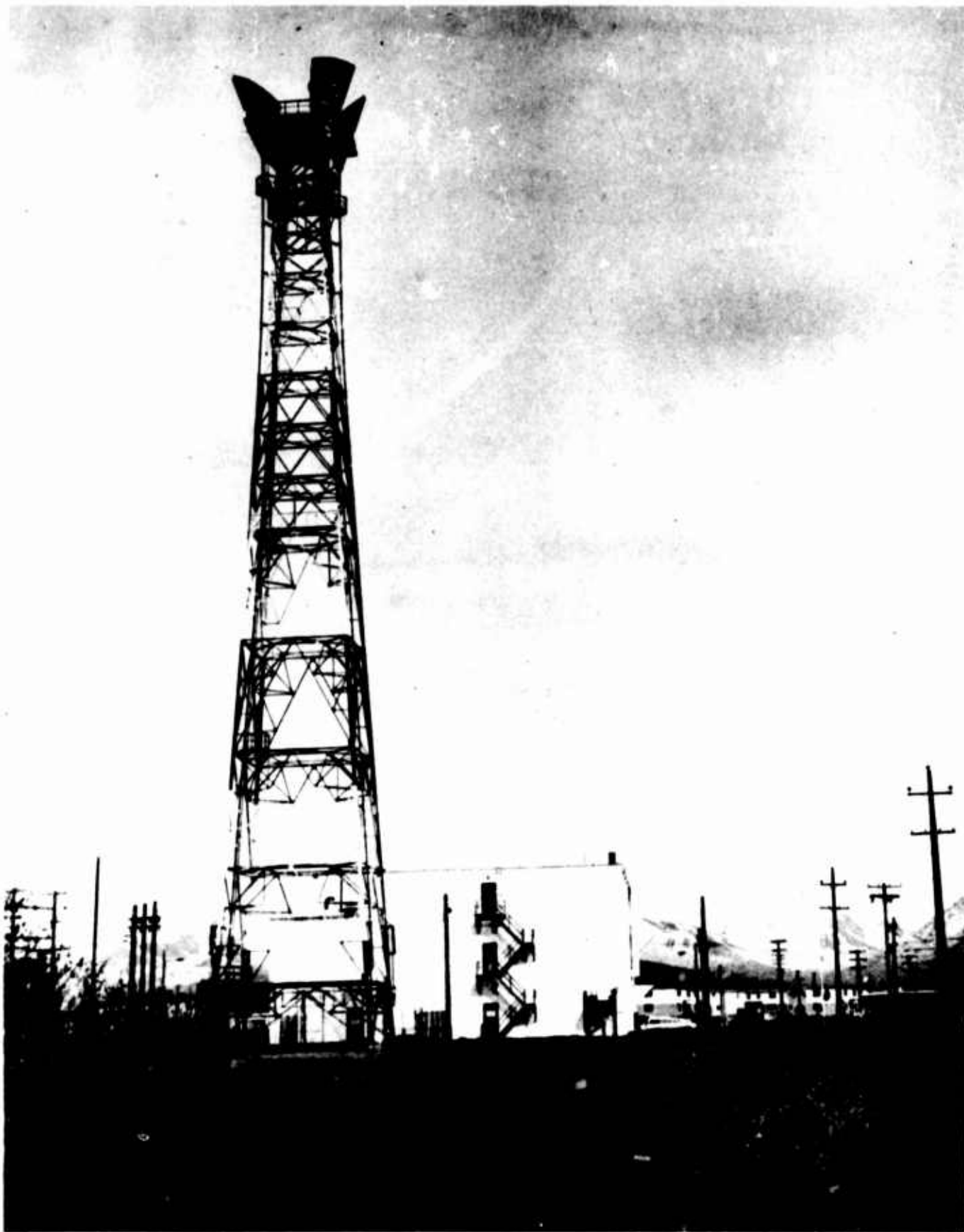


Figure 252. ACS Communications Tower on Government Hill (Undamaged)



Figure 253. Elmendorf AFB Warehouse (Aerial view of partially collapsed supply warehouse)



Figure 254. Elmendorf AFB Warehouse (Failed reinforced-concrete roofbeam seat--small horizontal ties were insufficient to resist lateral load)

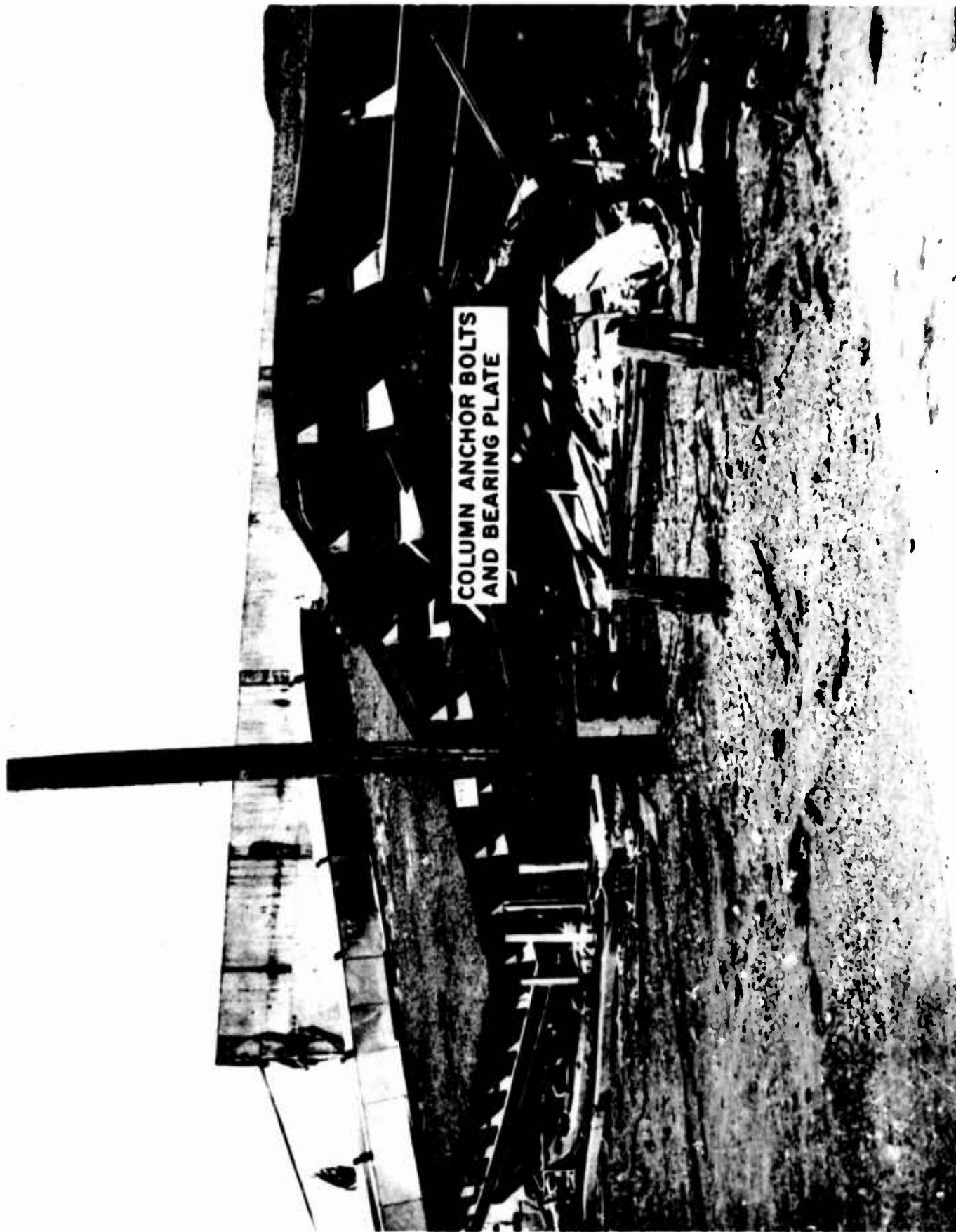


Figure 255. Elmendorf AFB Warehouse (Steel roof girder along south side of bay
three was supported on square-tied reinforced-concrete columns)

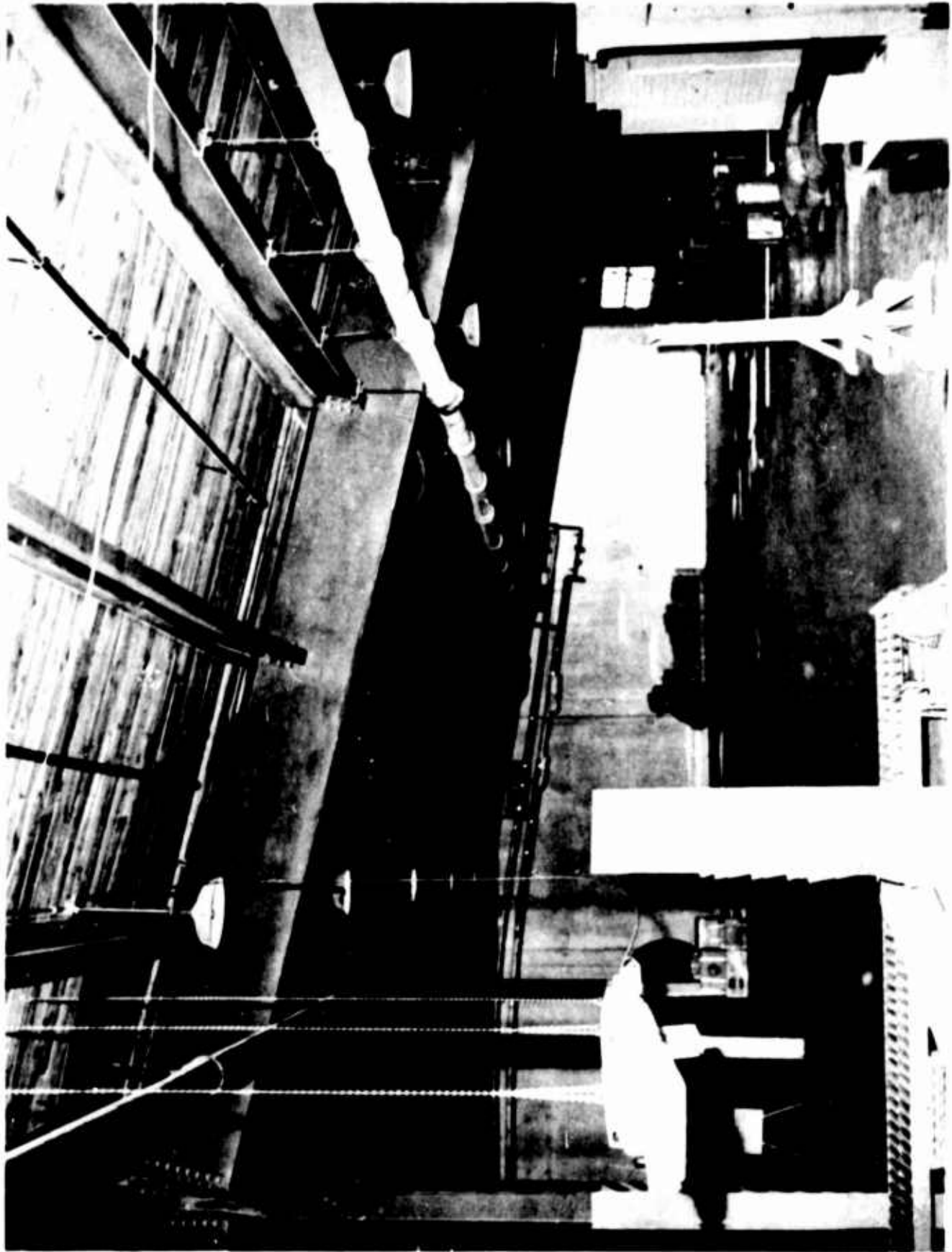


Figure 256. Elmendorf AFB Warehouse (Interior view showing lack of crossbracing)

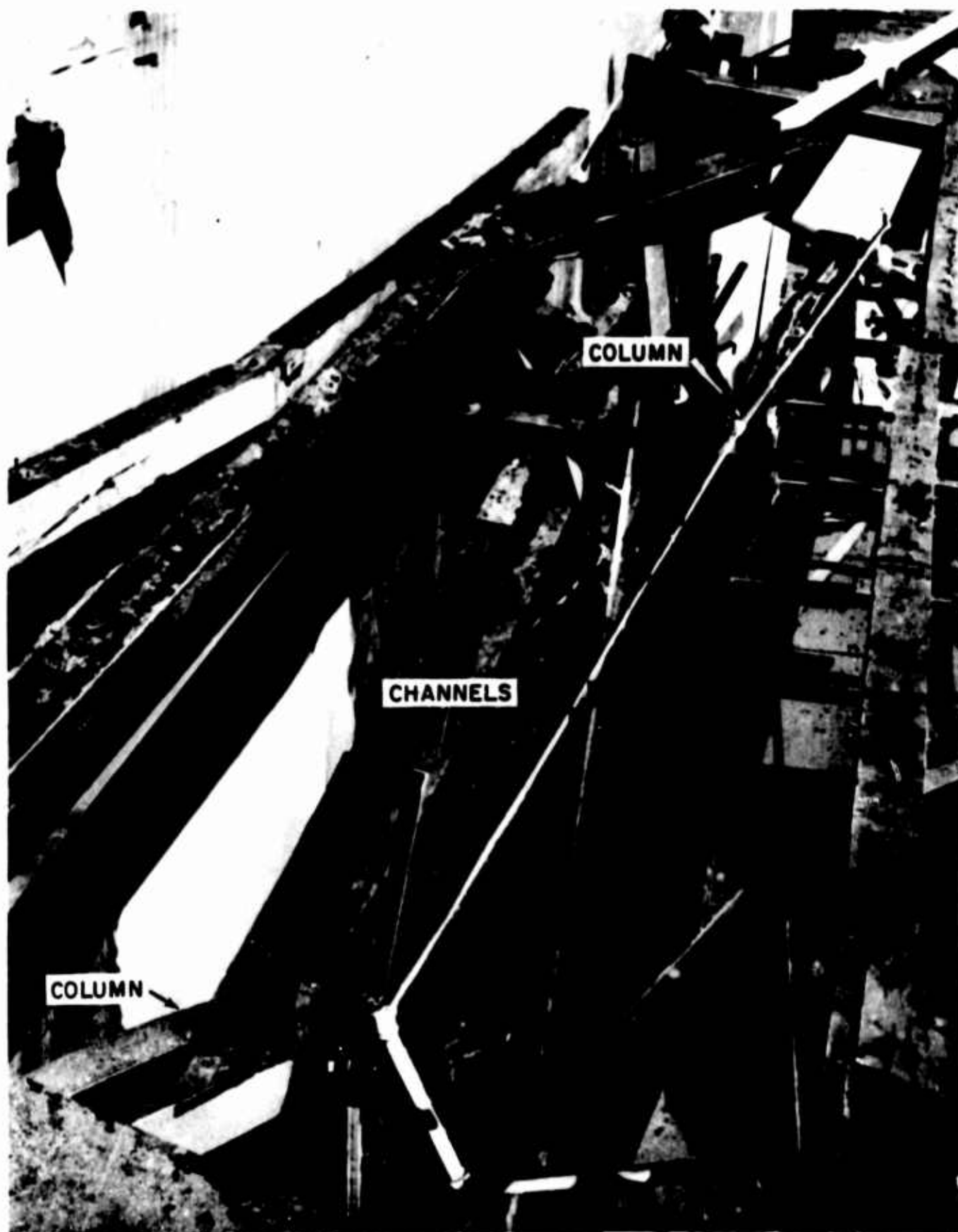


Figure 257. Elmendorf AFB Warehouse (Deformed sway bracing in a collapsed bay)



Figure 258. Elmendorf AFB Warehouse (Column failures along north wall of train shed)



Figure 259. Elmendorf AFB Warehouse (Closeup of column failure showing fracture of reinforcing steel)



Figure 260. Elmendorf AFB Warehouse (Closeup of column failure showing fracture of reinforcing steel)



Figure 261. Elmendorf AFB Warehouse
(Closeup of column failure showing tie-rod failure)

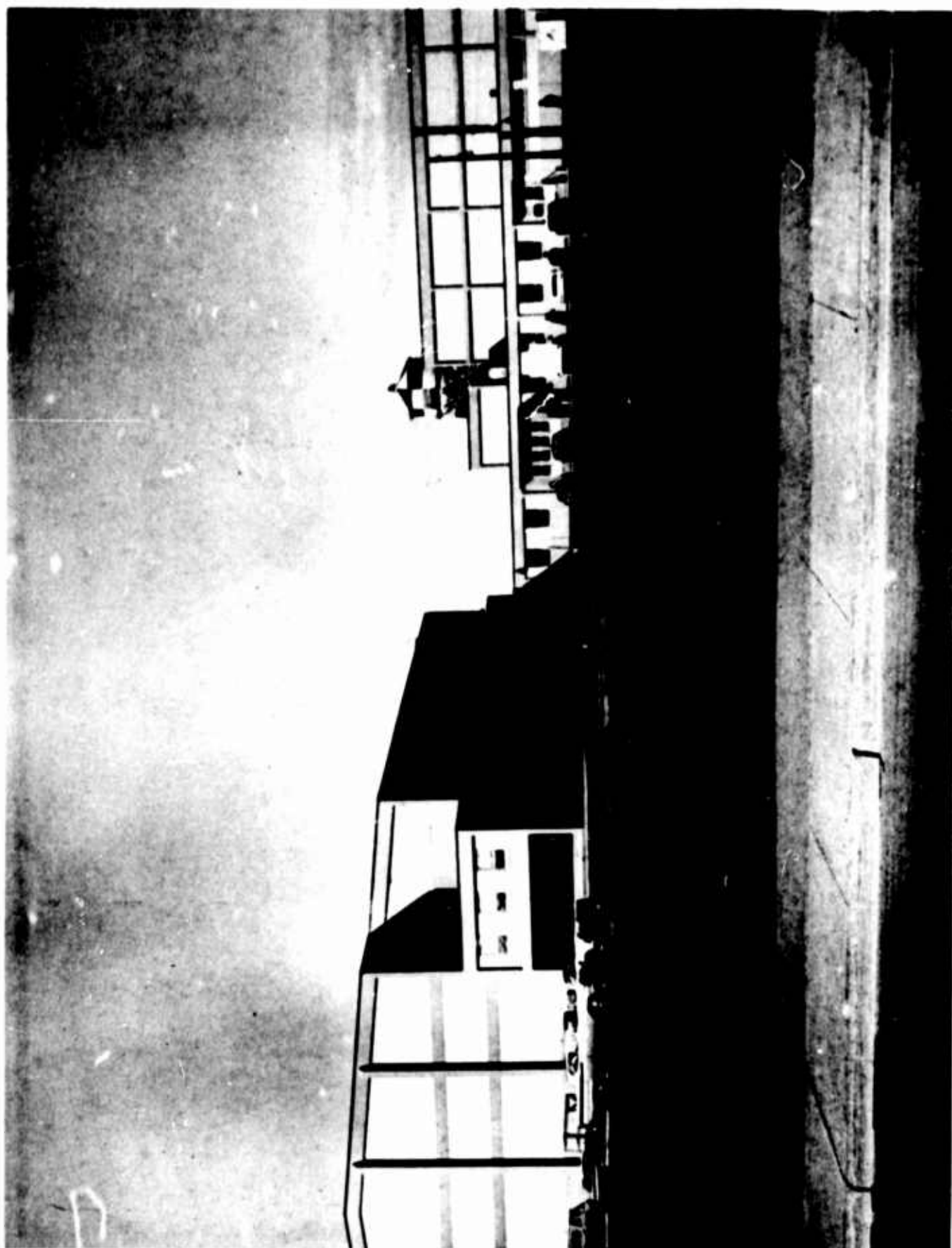


Figure 262. Elmendorf AFB Field House

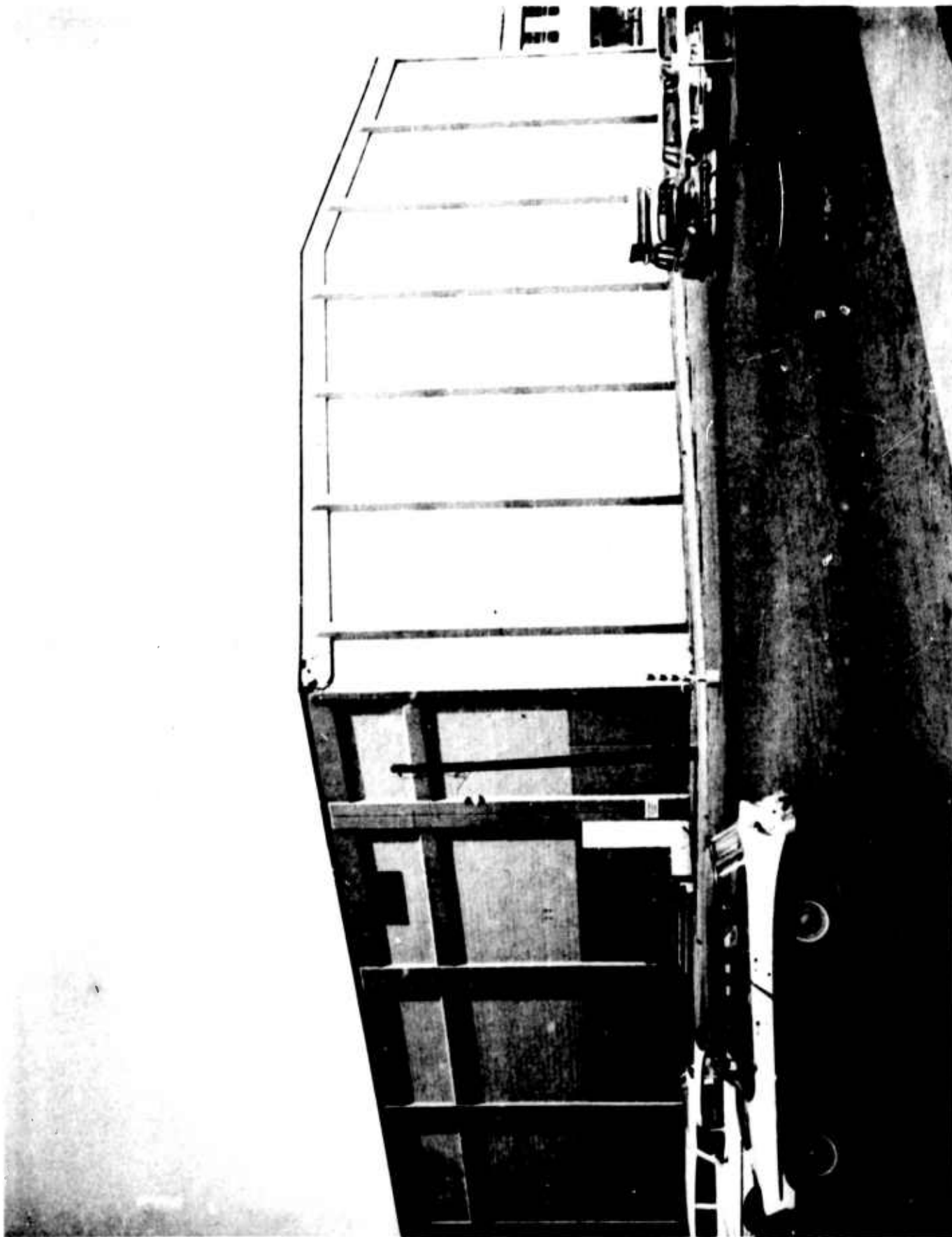


Figure 263. Elmendorf AFB Field House (Southwest corner of structure)

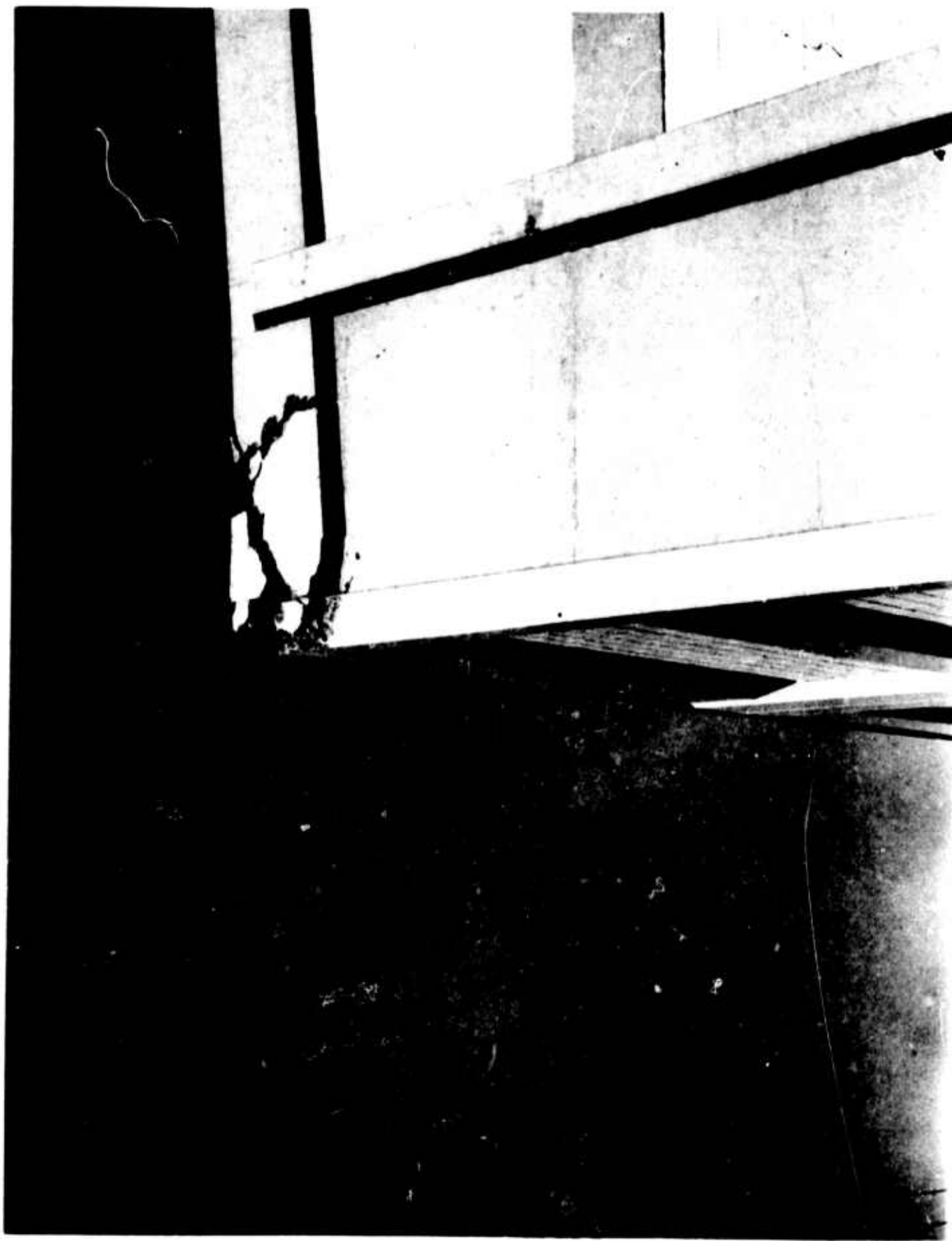


Figure 264. Elmendorf AFB Field House (Closeup of cracks in southwest corner of gymnasium caused by impact of steel rigid frame)



Figure 265. Elmendorf AFB Field House (A fallen piece of concrete from southwest corner of gymnasium showed few aggregate fractures)

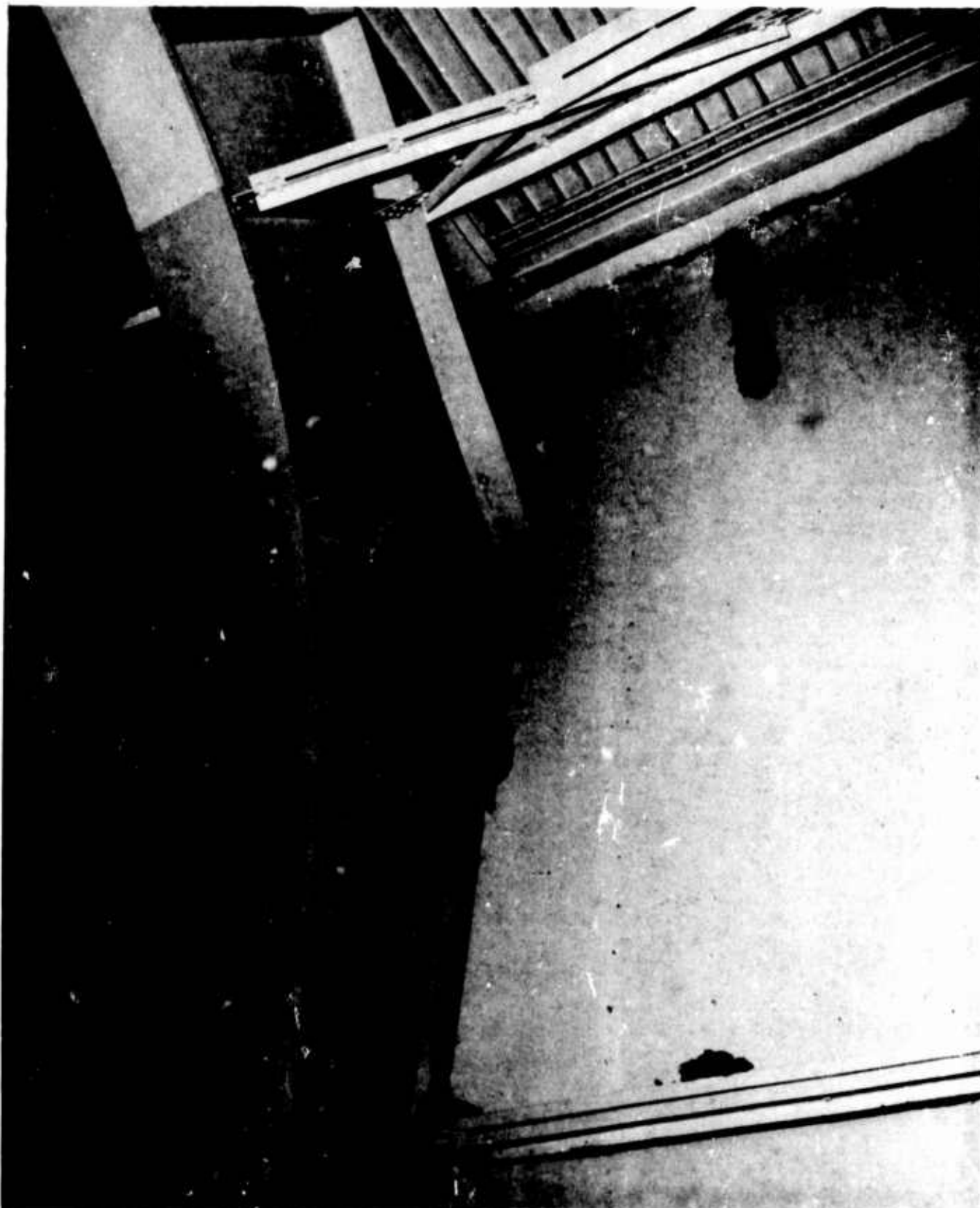


Figure 266. Elmendorf AFB Field House (Undamaged steel rigid frame inside gymnasium. Note indication of shock on plasterboard abutting frame.)



Figure 267. Elmendorf AFB Building 6-900



Figure 268. Elmendorf AFB Building 6-900
(Cracked masonry-block wall inside building)

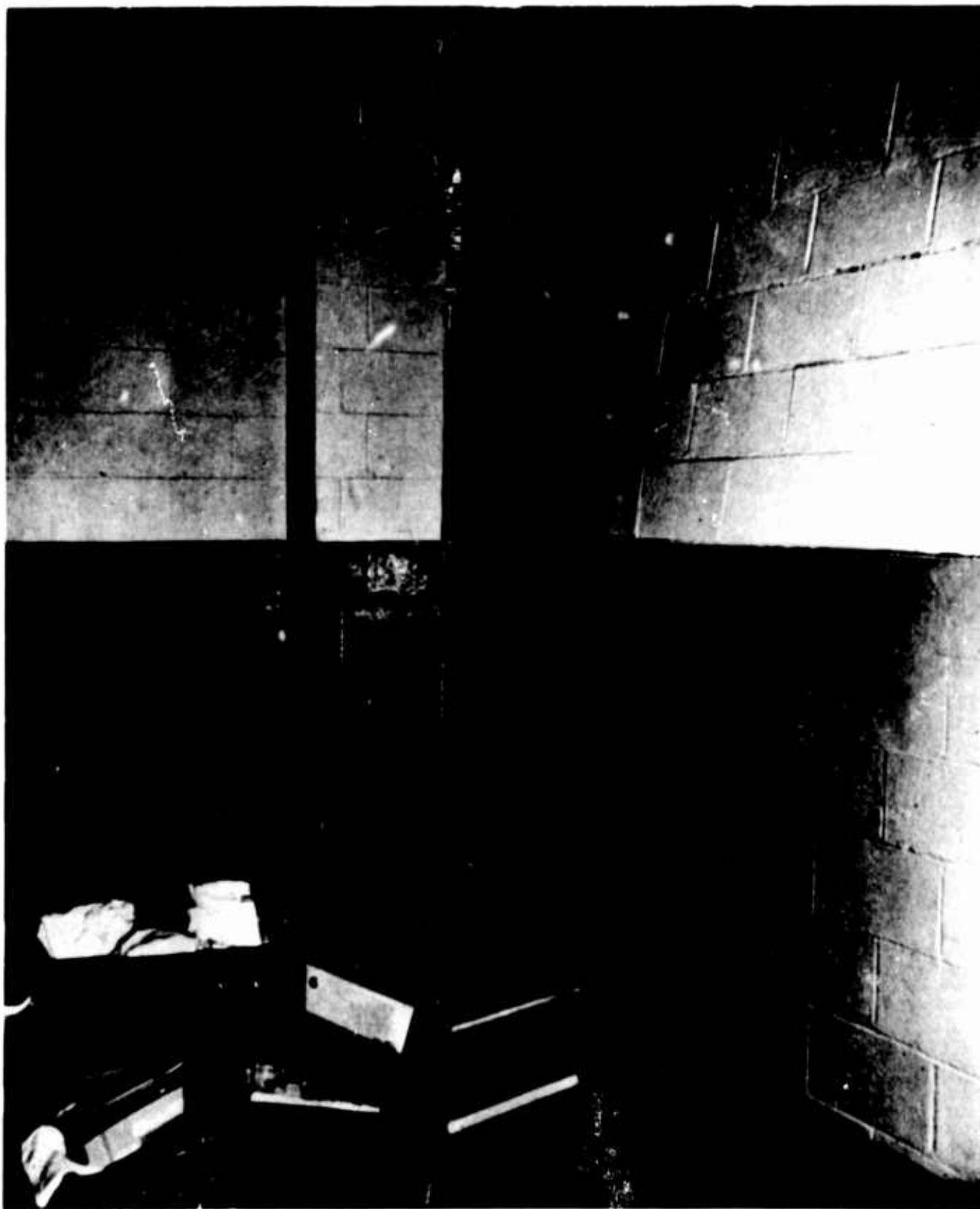


Figure 269. Elmendorf AFB Building 6-920
(Badly cracked masonry-block partition inside building)



Figure 270. Anchorage Westward Hotel (Aerial view of west side of fourteen-story tower)



Figure 271. Anchorage Westward Hotel (Reinforcement in place for another shear wall in tower. Original doorway in foreground will be eliminated.)



Figure 272. Anchorage Westward Hotel
(Reinforcement in place above a doorway in the plane of shear walls inside tower)

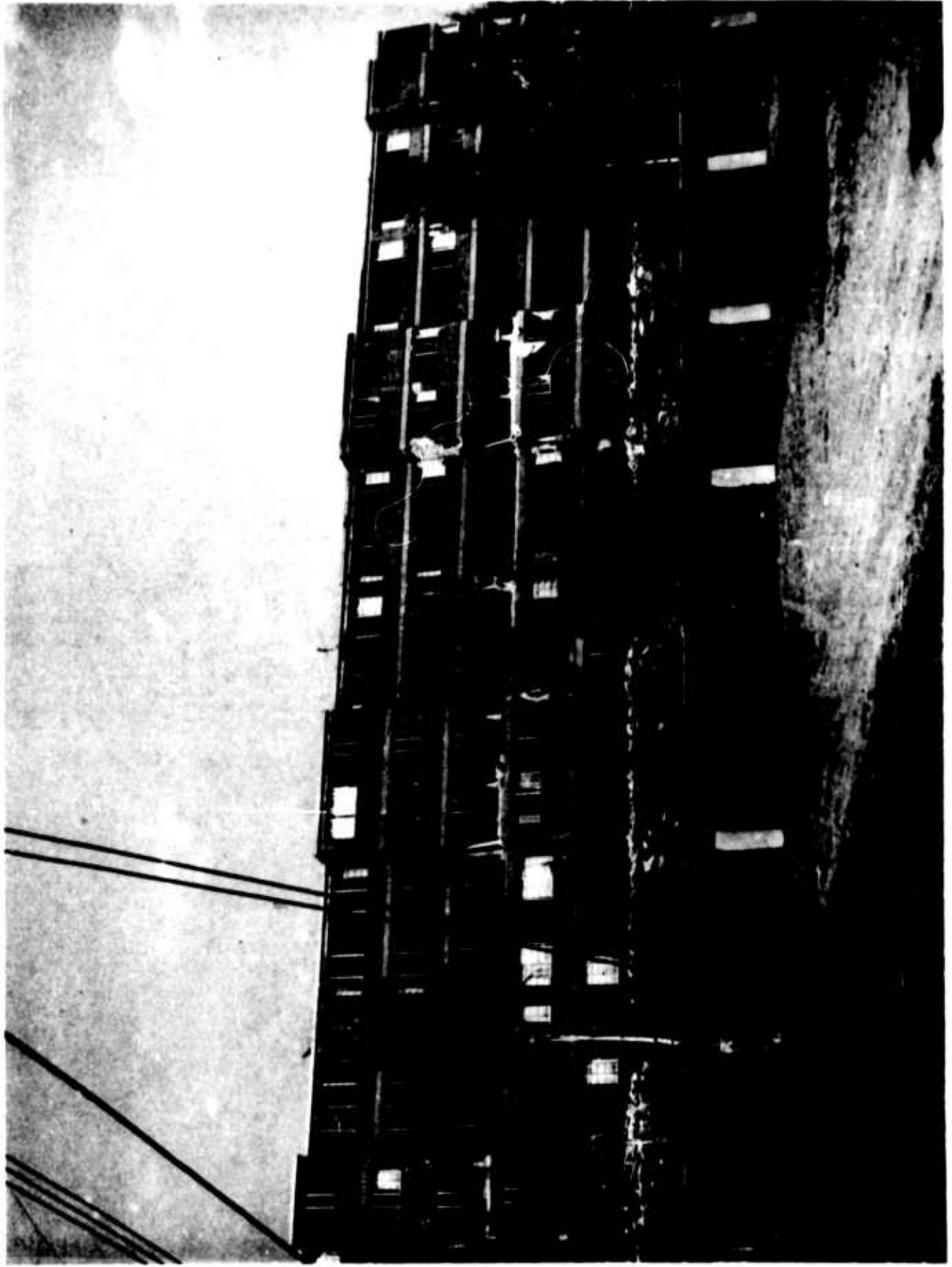


Figure 273. Hillside Apartments (Rear of battered building)

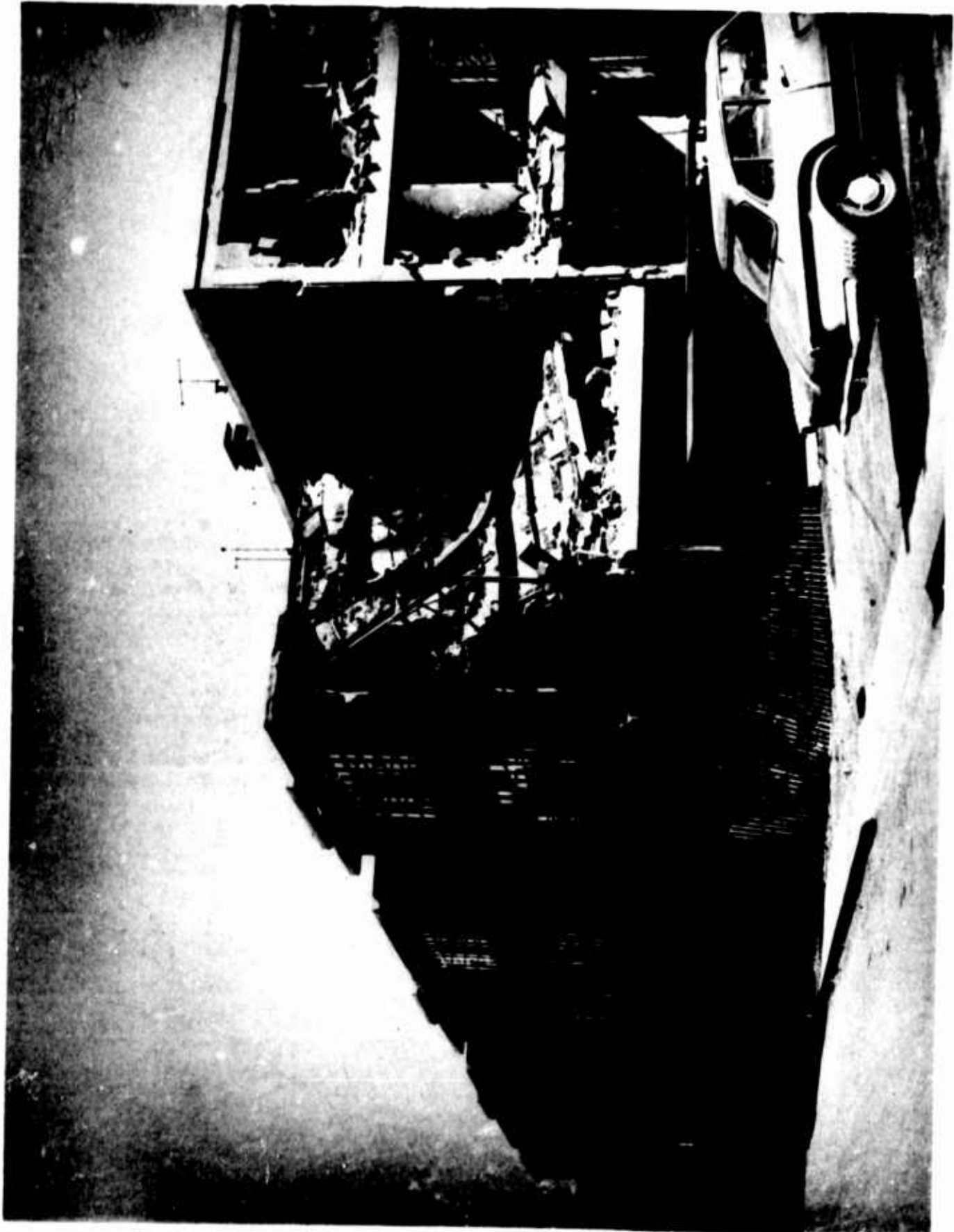


Figure 274. Hillside Apartments (Collapsed northwest corner)

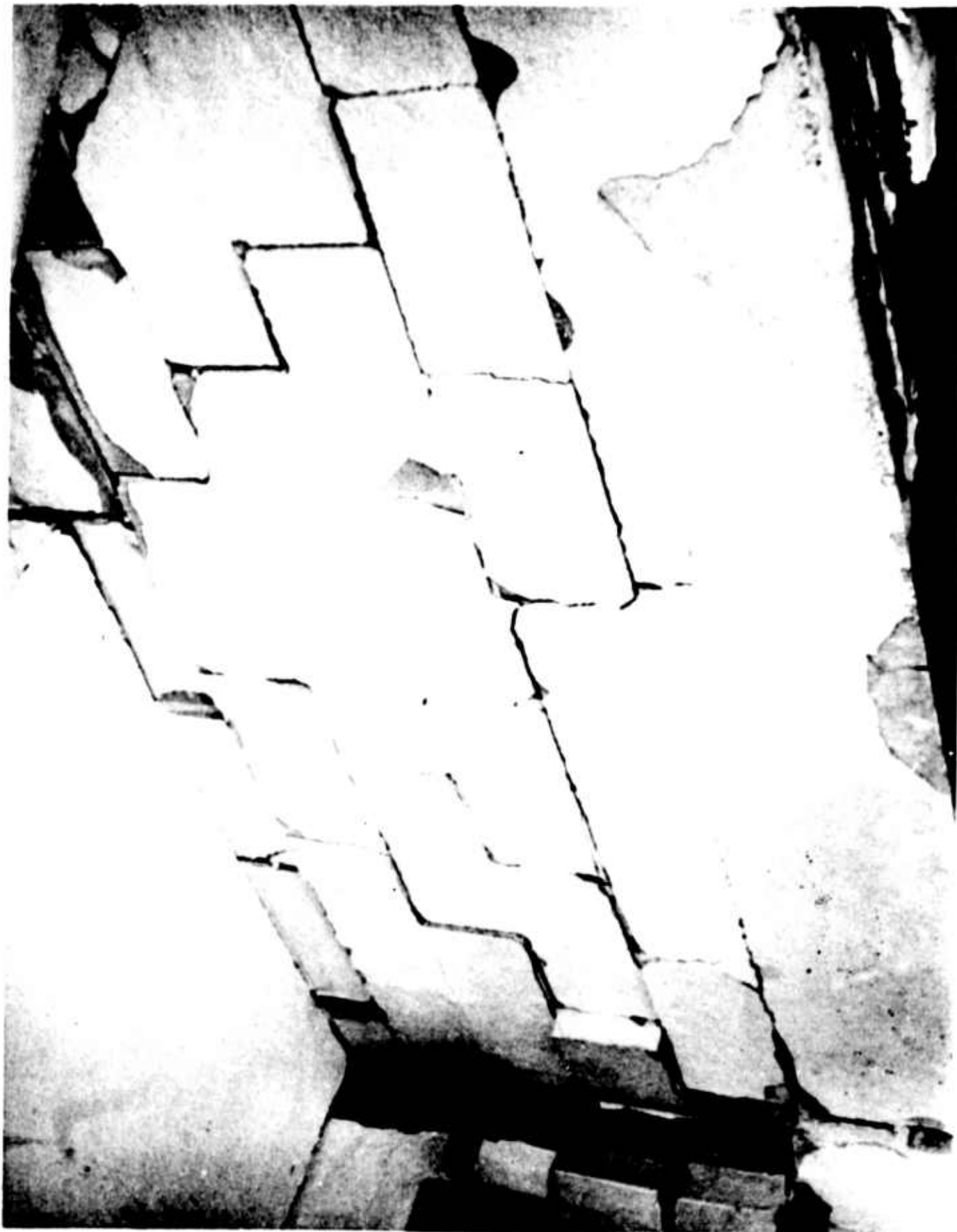


Figure 275. Hillside Apartments (Typical crack pattern of interior masonry-block walls)



Figure 276. Hillside Apartments (A masonry-block partition near northwest corner of building fell without cracking more than a few blocks)



Figure 277. Hillside Apartments (Window frames in rear of building remain suspended from steel beams after masonry-block walls around them fell)

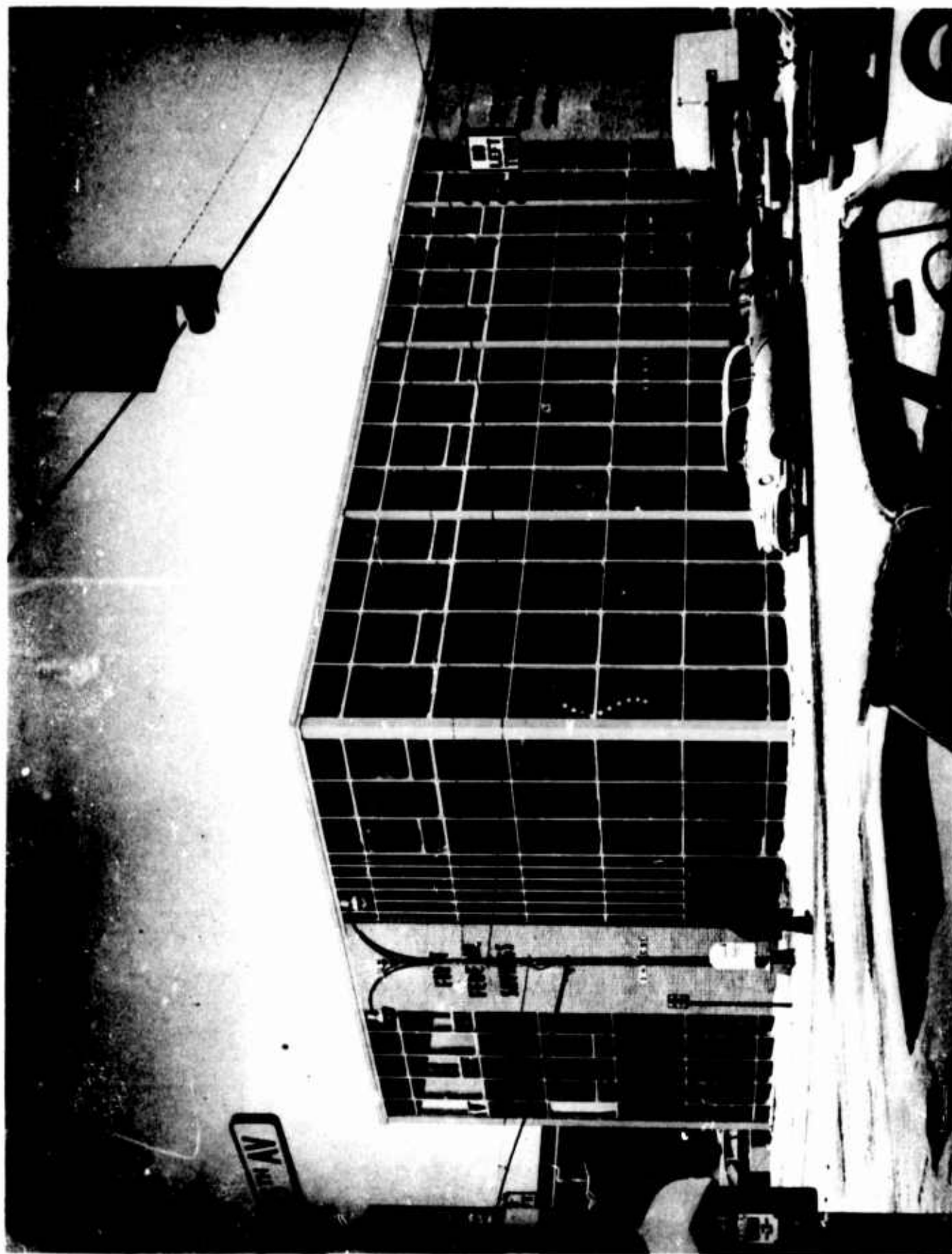


Figure 278. First Federal Savings and Loan Association Building
(Southeast corner of modern structure prior to the earthquake)

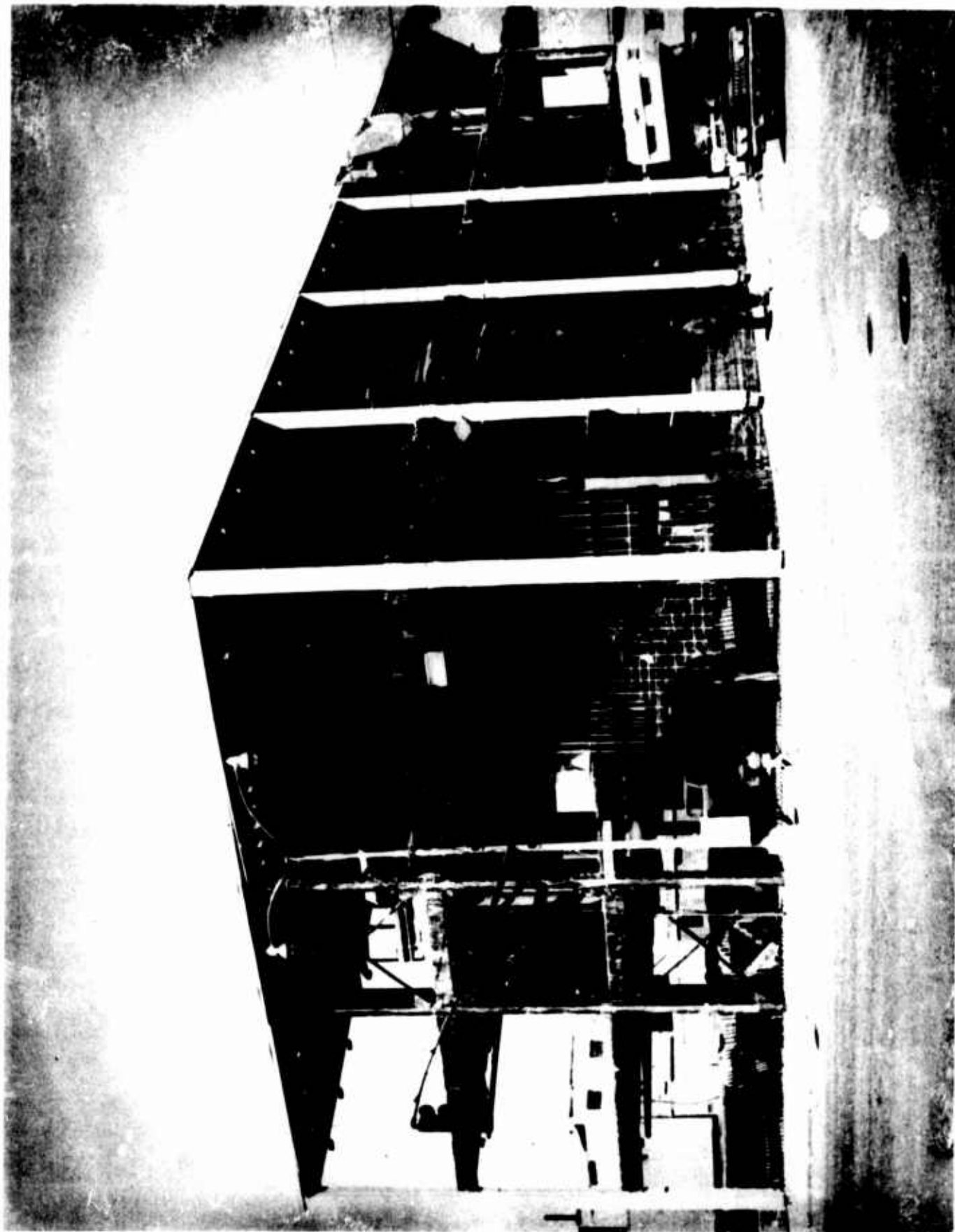


Figure 279. First Federal Savings and Loan Association Building (Exposed steel frame along west wall shows corrugated metal used as a bottom form for reinforced-concrete floors. Photo taken during demolition.)

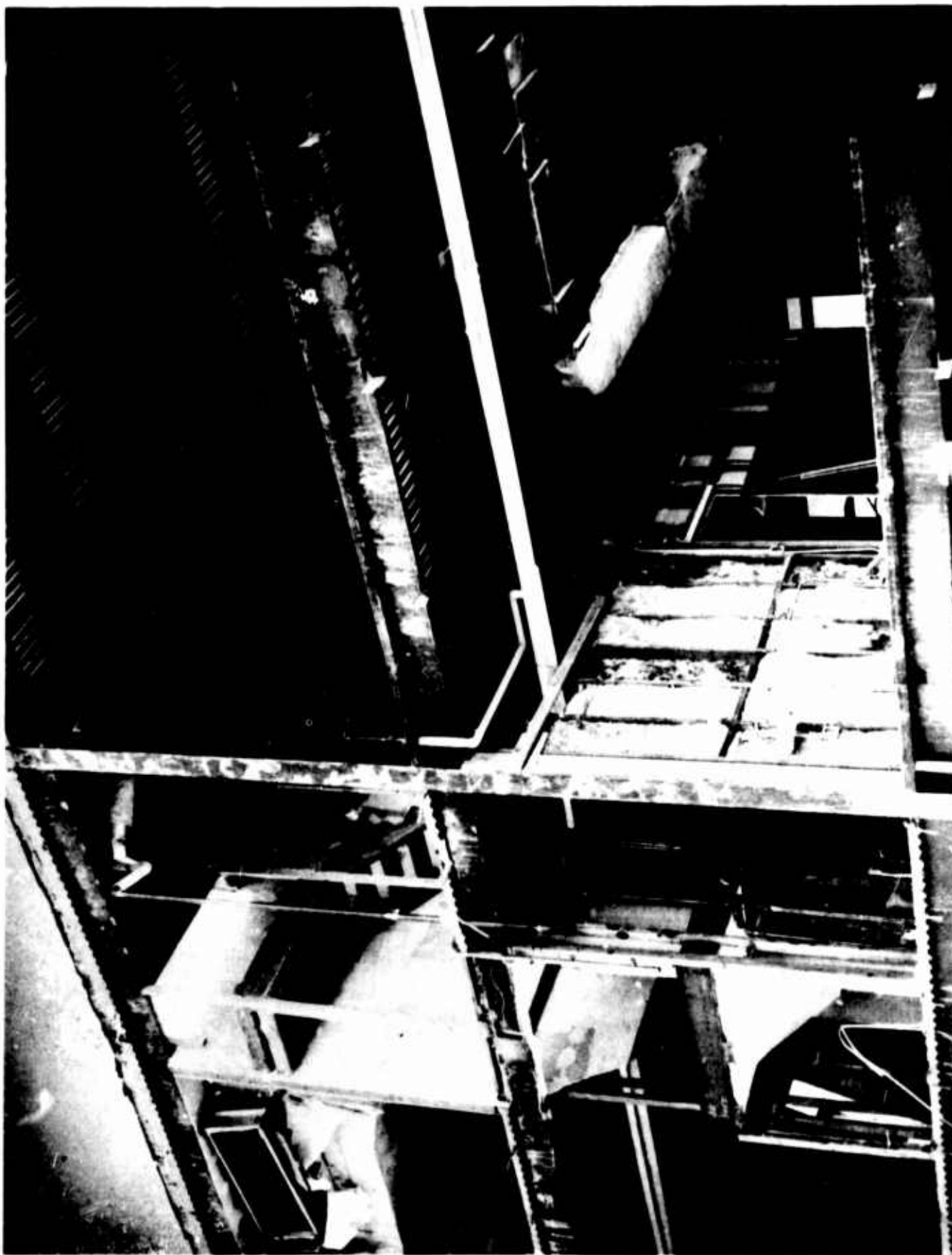


Figure 280. First Federal Savings and Loan Association Building
(Exposed steel frame showing stiffened panel in south wall)



Figure 281. First Federal Savings and Loan Association Building (Downtown Anchorage before the earthquake. The First Federal Savings and Loan Association Building is in right center.)

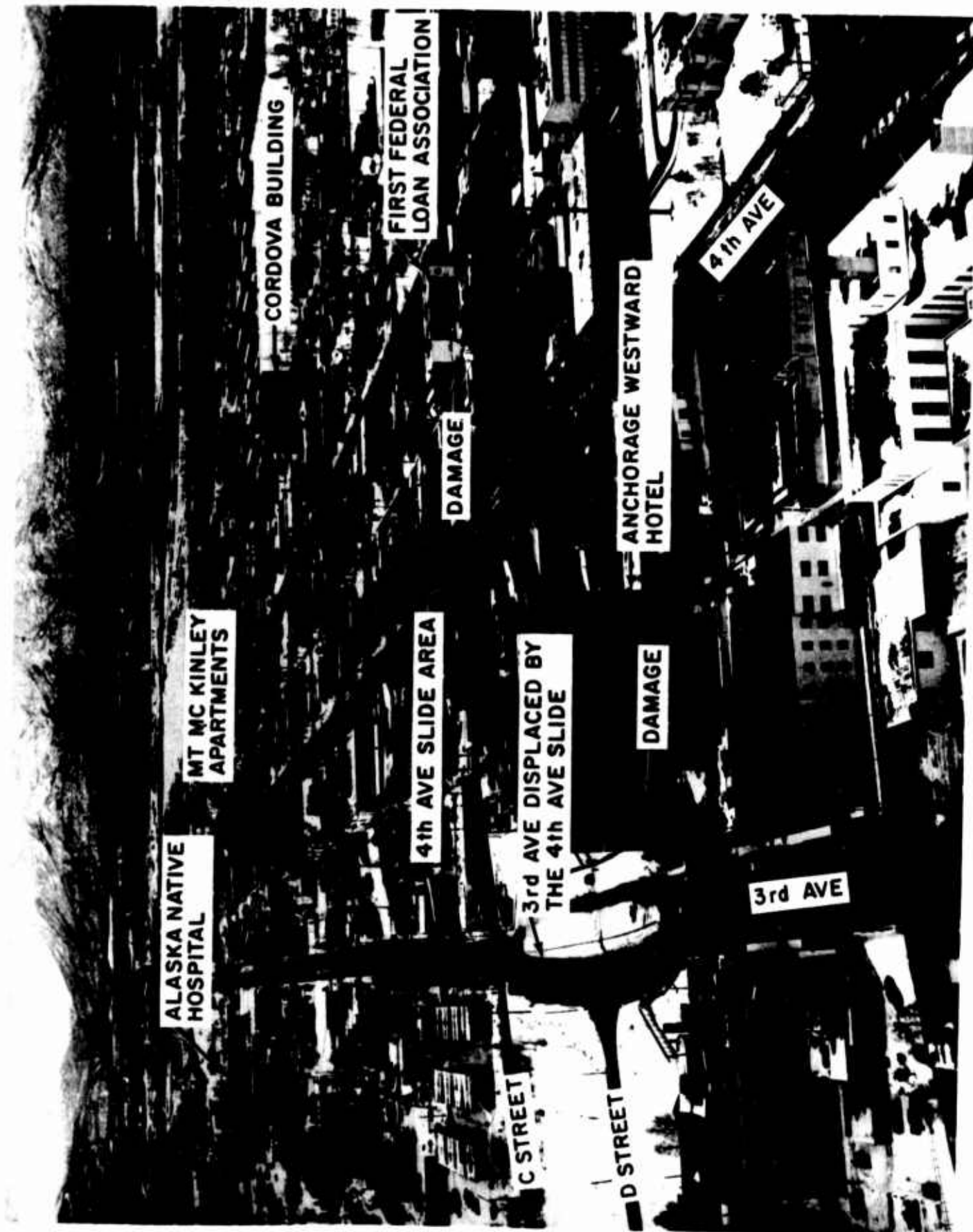


Figure 282. First Federal Savings and Loan Association Building (Aerial view of downtown Anchorage after the quake showing horizontal shear cracks in west wall of building)



Figure 283. Wright Way Auto Carrier Garage
(South end of building showing its steel frame and a few remaining masonry blocks)

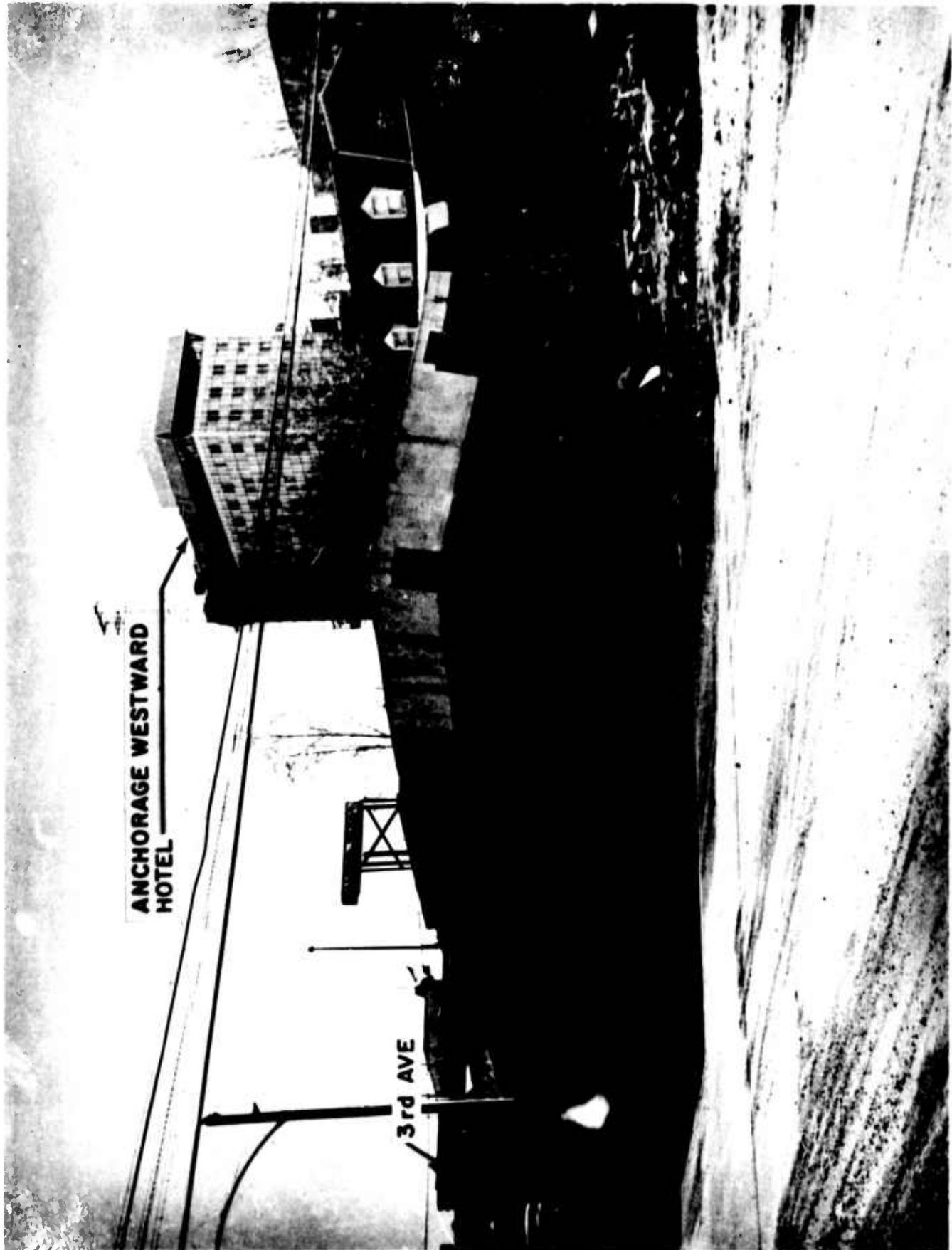


Figure 284. Dalton and Company Wholesale Supply Store (Northeast corner of building showing tilted steel pipe columns and many masonry blocks fallen intact)



Figure 285. Dalton and Company Wholesale Supply Store (Closeup of column base-anchorage failure)



Figure 286. Dalton and Company Wholesale Supply Store
(Northwest corner of building showing disintegrated masonry walls)



Figure 287. Elmendorf AFB Aircraft Maintenance Hangars
(South side of Building 32-060, one of two identical birchwood hangars)

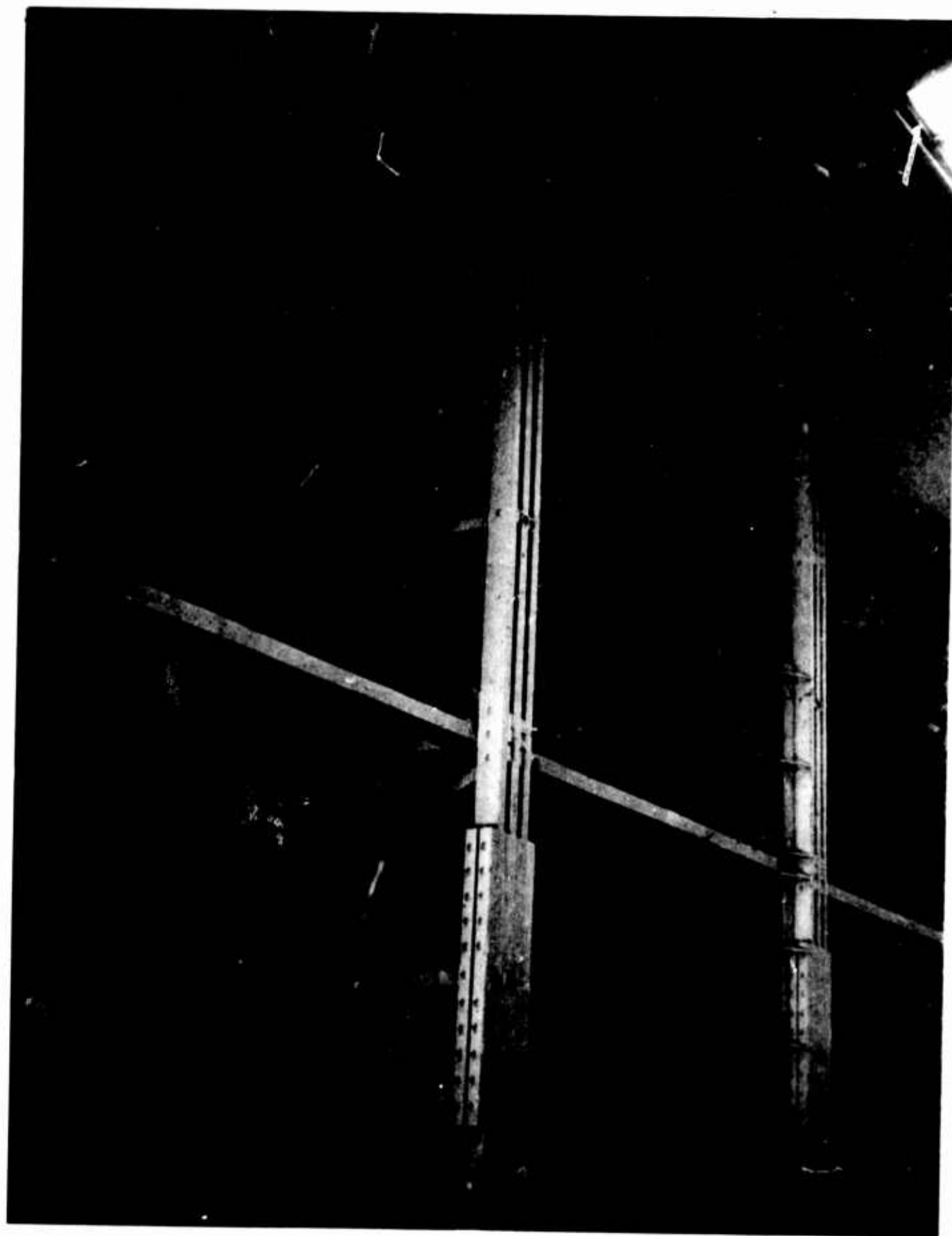


Figure 288. Elmendorf AFB Aircraft Maintenance Hangars (Bowstring roof-trusses inside a birchwood hangar)



Figure 289. Elmendorf AFB Aircraft Maintenance Hangars
(Crossbracing in the plane of the side wall of a birchwood hangar)

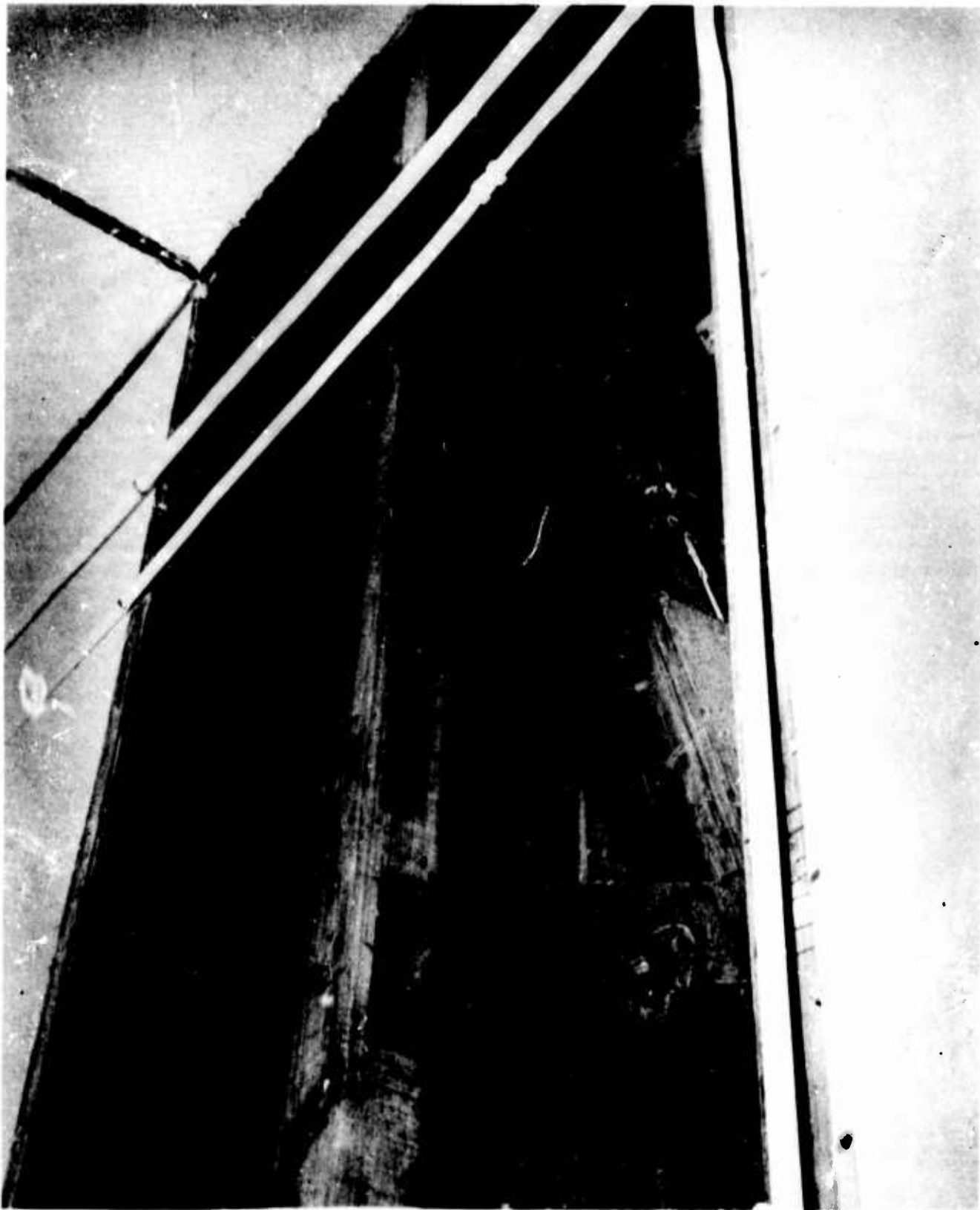


Figure 290. Elmendorf AFB Aircraft Maintenance Hangars
(Failure of inclined members started by splitting along
two lines of connecting bolts at a splice)



Figure 291. Elmendorf AFB Aircraft Maintenance Hangars
(Splice failure progressed from splitting to partial fracture)

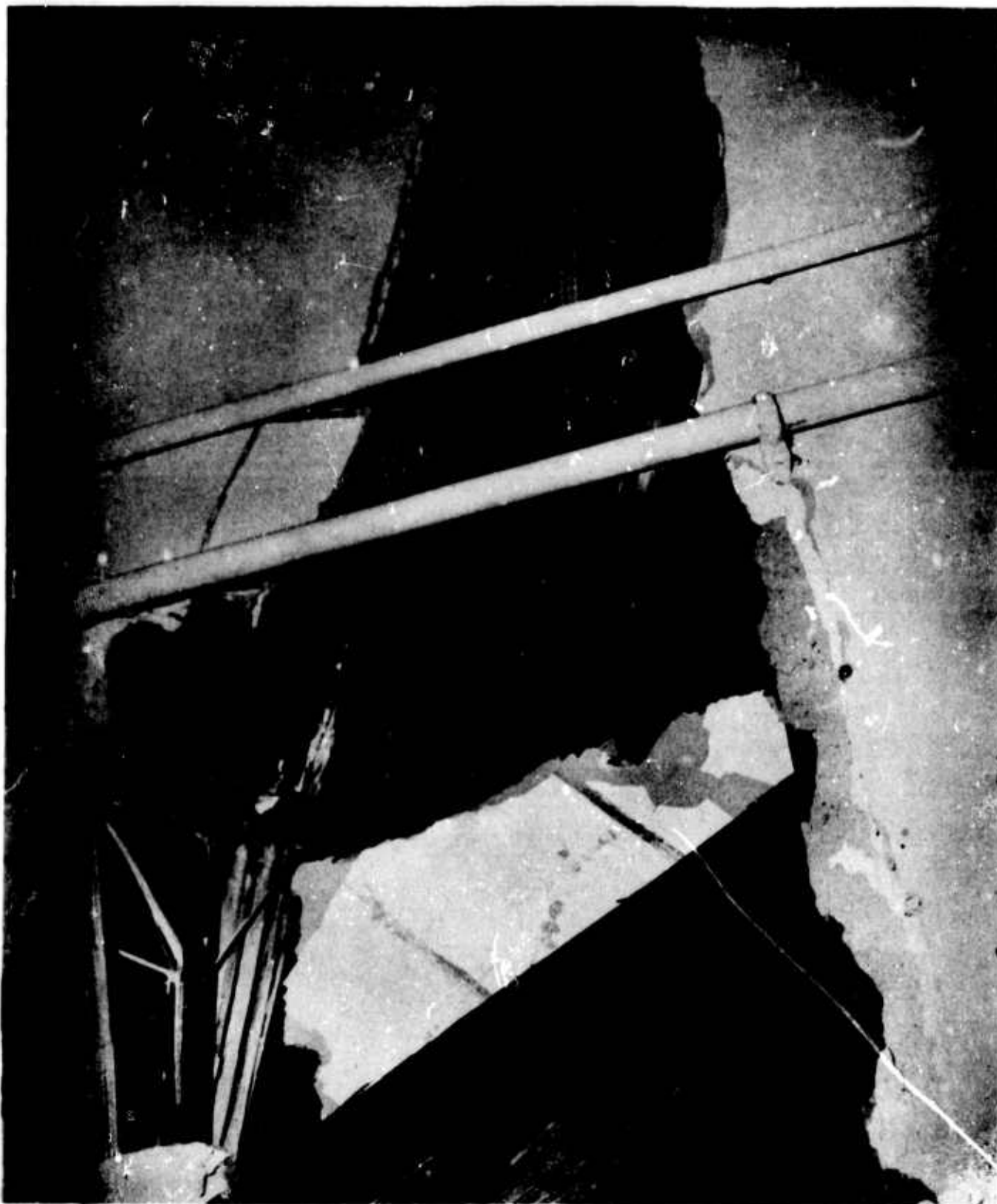


Figure 292. Elmendorf AFB Aircraft Maintenance Hangars
(In extreme cases the inclined member was completely fractured)

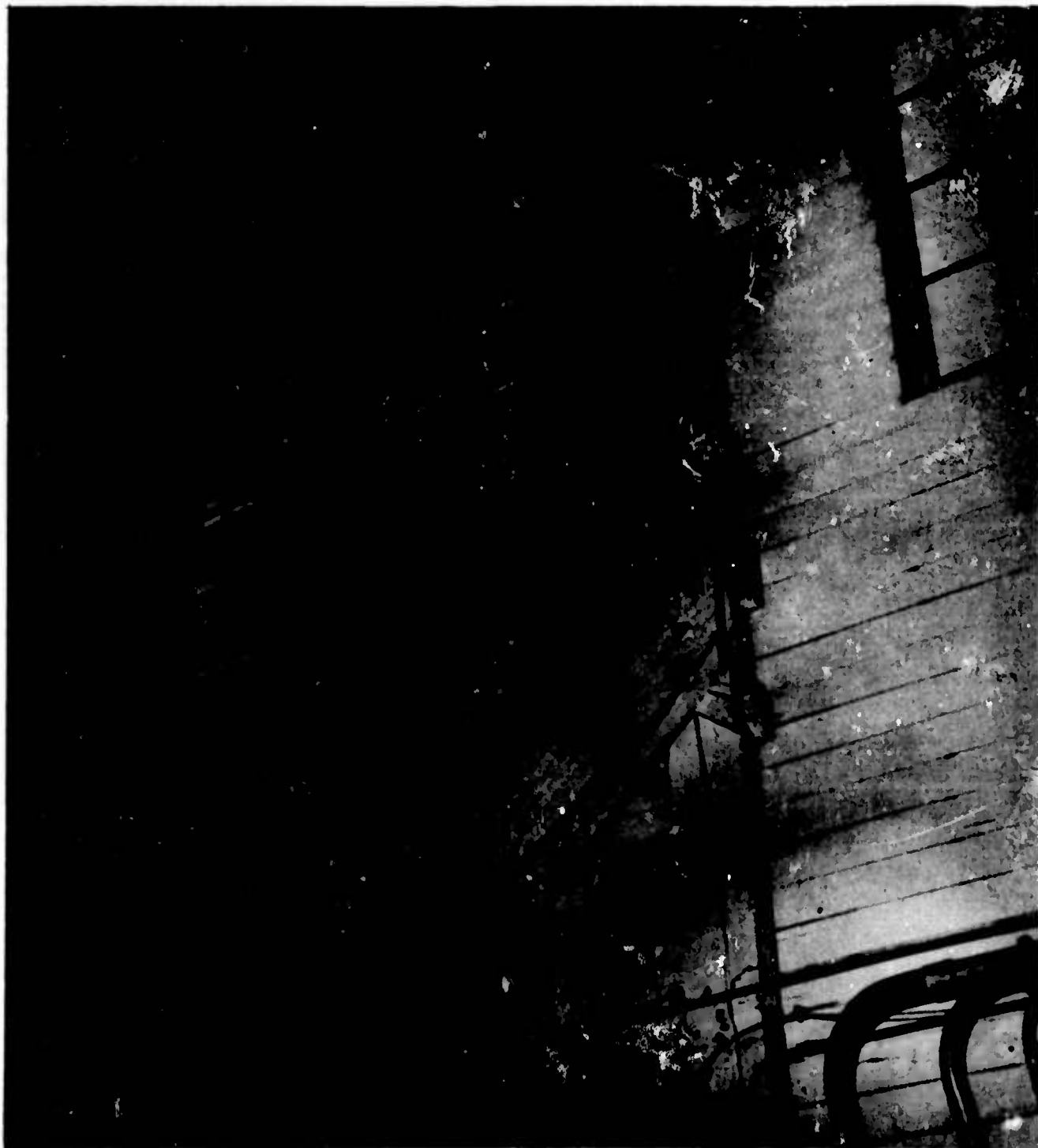


Figure 293. Elmendorf AFB Aircraft Maintenance Hangars
(Some crossbraces and vertical members split longitudinally along the grain)

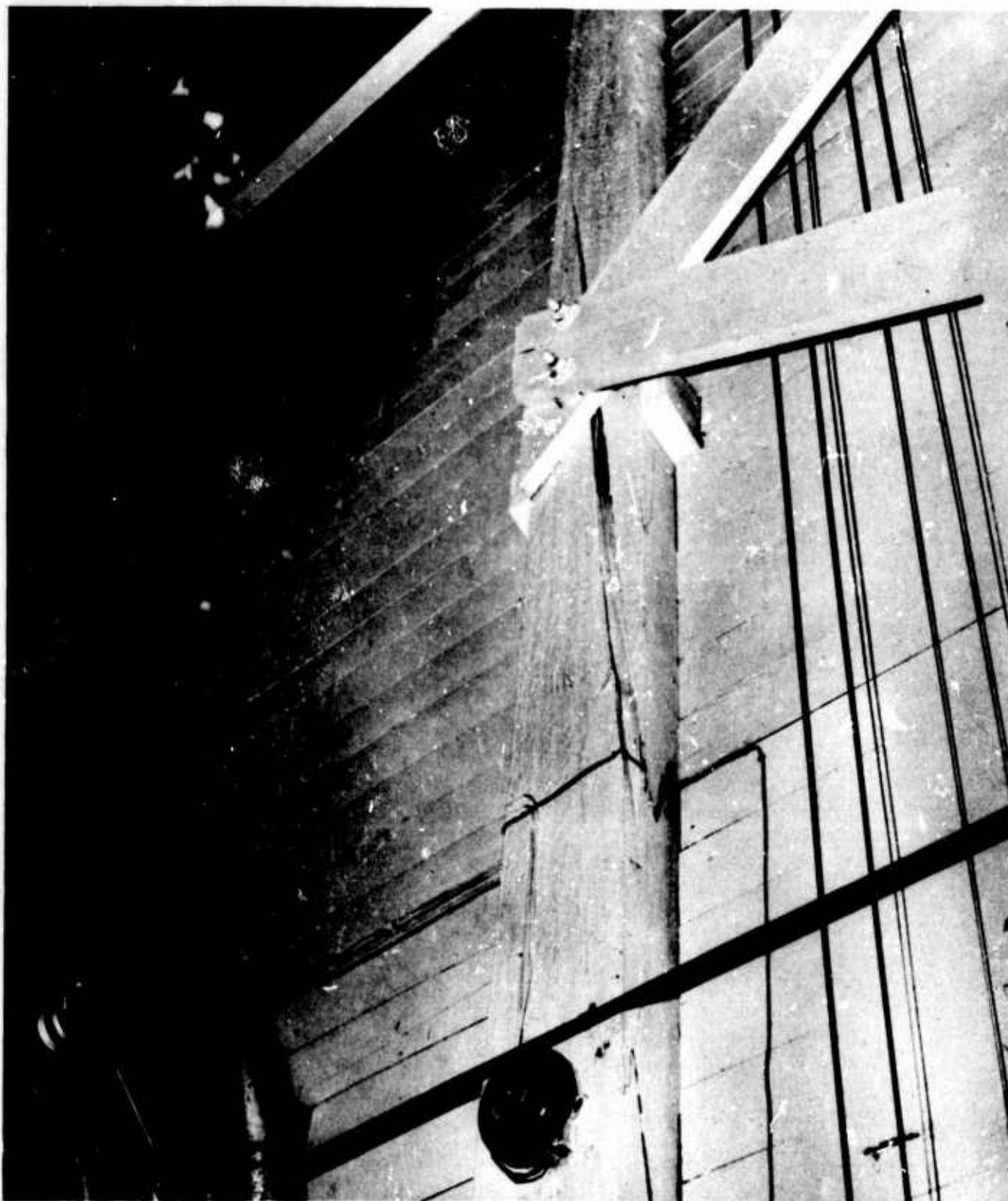


Figure 294. Elmendorf AFB Aircraft Maintenance Hangars
(Closeup of split vertical member at a crossbrace connection)



Figure 295. Elmendorf AFB Aircraft Maintenance Hangars
(Closeup of split vertical member at a splice)

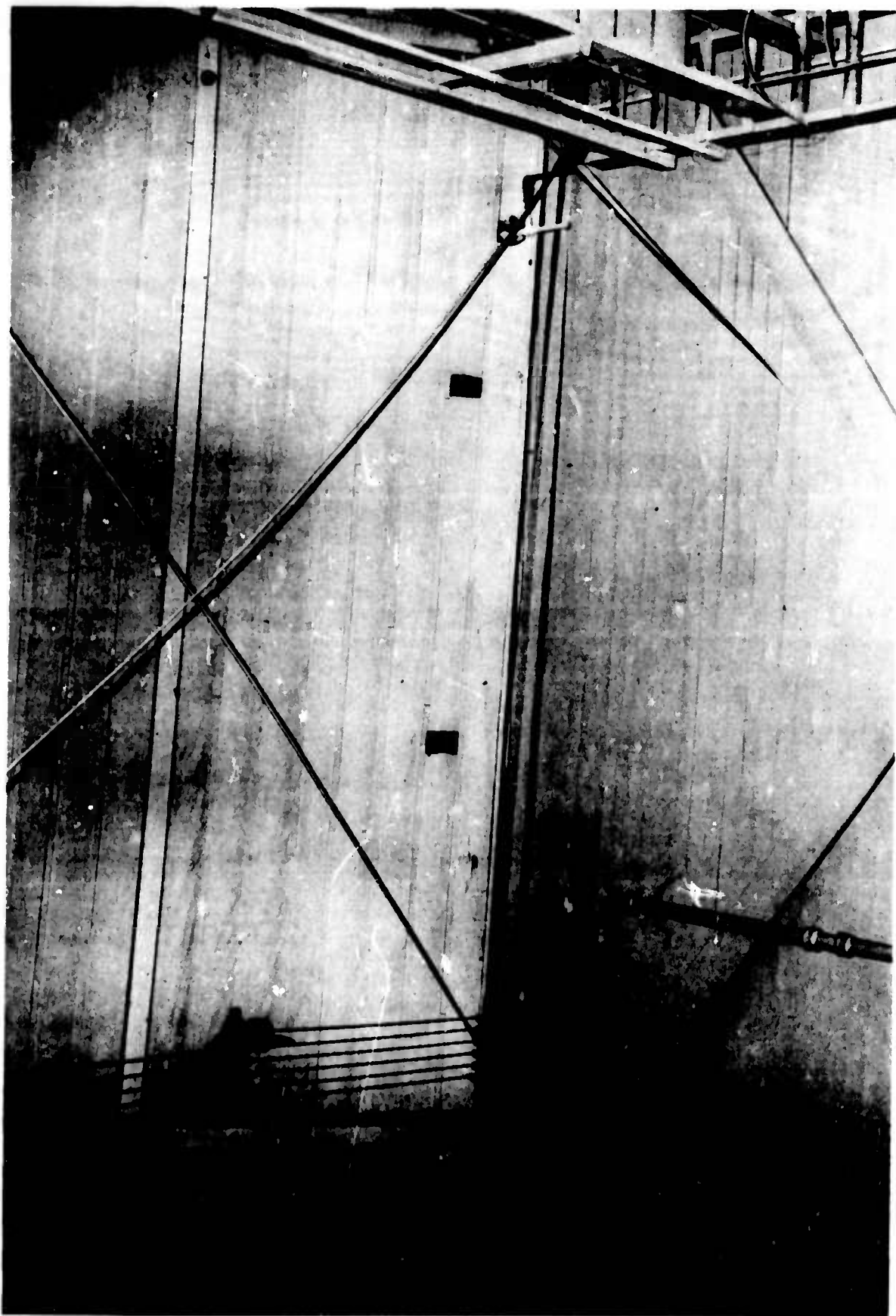


Figure 296. Elmendorf AFB Aircraft Maintenance Hangars (Split truss tie-rod anchor plate)

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		2b. GROUP
3. REPORT TITLE THE GREAT ALASKA EARTHQUAKE, Volume II, Illustrations and Maps		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) 1 May 1964-1 October 1964		
5. AUTHOR(S) (Last name, first name, initial) Fisher, Walter E., Ph.D.; Merkle, Douglas H., Captain, USAF		
6. REPORT DATE November 1965	7a. TOTAL NO. OF PAGES 334	7b. NO. OF REFS None
8a. CONTRACT OR GRANT NO. b. PROJECT NO. 5713 c. d.	9a. ORIGINATOR'S REPORT NUMBER(S) AFWL-TR-65-92, Vol II	
9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)		
10. AVAILABILITY/LIMITATION NOTICES DDC release to OTS is authorized.		
11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY AFWL (WLDC) Kirtland AFB, NM 87117	
13. ABSTRACT Volume II of AFWL-TR-65-92, <u>The Great Alaska Earthquake</u> , consists of the photographs, maps, and drawings which supplement Volume I of this report. Credits for these illustrations are given in the Foreword.		

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Epicenter						
Tsunami (seismic sea wave)						
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